DOCUMENT RESUME

ED 351 997 IR 015 825

AUTHOR Wells, Rosalie
TITLE Computer-Mediated Communication for Distance Education: An International Review of Design, Teaching, and Institutional Issues. ACSDE Research Monograph Number 6.
INSTITUTION Pennsylvania State Univ., University Park. American Center for the Study of Distance Education.
REPORT NO ISBN-1-877780-07-3
PUB DATE 92
NOTE 80p.
AVAILABLE FROM American Center for the Study of Distance Education, Penn State University, 403 S. Allen St., Suite 206, University Park, PA 16802-5202 ($20).
PUB TYPE Information Analyses (070) -- Viewpoints (Opinion/Position Papers, Essays, etc.) (120) -- Reports - Research/Technical (143)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Access to Education; Computers; *Distance Education; Educational Technology; *Electronic Mail; Elementary Secondary Education; Higher Education; *Instructional Design; Instructional Innovation; Microcomputers; Nontraditional Education; Telecommunications; *Teleconferencing
IDENTIFIERS *Computer Mediated Communication; Empirical Case Study

ABSTRACT

One of the most recent technological systems to be adopted for use in distance education is computer-mediated communication (CMC), which typically includes computer conferencing, electronic mail, and electronic bulletin boards. The purpose of this review is to provide teachers, researchers and administrators with a practical summary of current knowledge about design, teaching, and institutional issues in the use of CMC for distance education, and to consolidate the major questions and issues in order to provide a relatively comprehensive overview of the field at this point in time. The review, which focuses on empirical studies using CMC in distance education, is divided into four parts: (1) Designing a Course To Maximize the Potential of CMC; (2) Teaching Considerations; (3) Institutional Issues (including computer access and marketing, policy, and cost); and (4) two charts illustrating the educational and communication uses of CMC which emphasize the extent to which CMC has become an international phenomenon. (Contains 181 references.) (ALF)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED351997

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

IR015825

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY

Michael G. Moore

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Computer-Mediated Communication for Distance Education: An International Review of Design, Teaching, and Institutional Issues

Rosalie Wells

Number 6 in the series **Research Monographs**

American Center for the Study of Distance Education
College of Education
The Pennsylvania State University

©The Pennsylvania State University
All Rights Reserved. Published 1992
Printed in the United States of America

The American Center for the Study of Distance Education
College of Education
The Pennsylvania State University
403 South Allen Street, Suite 206
University Park, PA 16801-5202

ISBN 1-877780-07-3

TABLE OF CONTENTS

FOREWORD i

INTRODUCTION 1

PART ONE

Designing a Course to Maximize the Potential of CMC 4

PART TWO

Teaching Considerations 12

PART THREE

Institutional Issues 20
Section I: Computer Access 20
Section II: Marketing, Policy, and Cost 29

PART FOUR

Charts 34
A Selection of Educational Uses of CMC 35
A Selection of Communication Uses of CMC 44

REFERENCES 56

ABOUT THE AUTHOR 69

DEOS

Distance Education Online Symposium

In April, 1991, the Penn State based American Center for the Study of Distance Education established **DEOSNEWS**, a free, weekly, international, electronic journal for distance education. Morten Flate Paulsen is its editor and systems designer. **DEOSNEWS** has more than 900 subscribers in 40 countries. However, it is difficult to estimate the total number of **DEOSNEWS** readers since some of the subscribers are bulletin boards that are accessed by large numbers of people. Scholars, researchers, administrators, and students are invited to submit articles about distance education to **DEOSNEWS**. Please send your articles to: **MFP1Ø1@PSUVM.PSU.EDU**

DEOSNEWS

Selected DEOSNEWS Articles:

GO MEEC! A Goal Oriented Method for Establishment of an Electronic University

Moderating Educational Computer Conferencing

The Electronic University: Computer Conferencing in Mass Education

Innovative Computer Conferencing Courses

Computer Networks for Teaching and Research

To subscribe to **DEOSNEWS**, just post the following command to:

LISTSERV@PSUVM.PSU.EDU
SUBSCRIBE DEOSNEWS Your Full Name

DEOS-L

DEOS-L is a free international discussion forum for distance education established to facilitate discussion of the issues presented in **DEOSNEWS**, as well as other issues of interest for distance educators. **DEOS-L** disseminates information and posts requests about distance education around the world and is open for everyone who wants to subscribe.

To subscribe to DEOS-L, just post the following command to:

LISTSERV@PSUVM.PSU.EDU
SUBSCRIBE DEOS-L Your Full Name

For more information about **DEOSNEWS** and **DEOS-L**, contact Morten Flate Paulsen at:

The American Center for the Study of Distance Education
College of Education
The Pennsylvania State University
403 South Allen Street, Suite 206
University Park, PA 16801-5202
Internet: MFP1Ø1@PSUVM.PSU.EDU

FOREWORD

The last two decades have seen an enormous growth in the provision of distance education, partly as a consequence of the cost effectiveness of industrialized production and delivery systems; equally important has been the acceptance of programs and courses by students. Distance modes have empowered students to determine when, where, and how they study and so have freed them from the constraints of face-to-face instruction.

The price paid is isolation from one's peers and limited access to information resources. The former inhibits group learning activities, such as projects and seminars, and precludes immediate tutor feedback, leaving students unable to assess their performance and progress. The latter forces students to become passive recipients of pre-digested learning materials instead of active searchers for knowledge. Postal library facilities, such as those offered by Athabasca University, do much to mitigate the problem, but they are a poor substitute for a bookshelf of the latest journals.

Distance institutions have been amongst the most innovative users of new media and the convergence of computing and telecommunications provides yet another opportunity to exploit new technologies to enhance delivery systems. The cost of personal computers has fallen to the point where a basic machine may be purchased for little more than tuition fees, and, since the deregulation of the telecommunications monopolies, modems may be purchased for less than $100. Combined, these tools have the potential to link together even the remotest students and to provide them with on-line access to the world's greatest libraries.

The case studies cited in this review show that computer-mediated communication (CMC) can offer a viable alternative to the more traditional delivery modes and can facilitate peer support groups. The examples also testify to the diversity of opinion surrounding CMC and illustrate how teachers have learned to adapt to and exploit its flexibility in satisfying the requirements of a wide range of courses.

But so far much of the development of teaching applications has occurred at the grassroots level and the successes have been achieved by small groups of teachers and support staff. Structural, attitudinal, and social obstacles to technology usage endure and the vast majority of administrators and faculty simply have no sense of the implications and the possibilities of using technology to teach. This review provides all those engaged in distance education with a practical summary of the current experience of the design, teaching, and institutional issues of CMC delivered courses. The question and answer format also ensures that the text is readily accessible to newcomers attempting to initiate their own CMC activities.

The review also highlights some of the limitations of current CMC systems. Perhaps the most crucial is that they are text-based, thus constraining groupwork and handicapping those lacking the skills of written discourse. Textual systems also limit the options for science, technology, and engineering programs. However, a shift to graphics-based systems will require the equivalent of a hundred-fold increase in data transmission rates, so it may have to await the widespread implementation of ISDN (Integrated Services Digital Network) or the adoption of new data compression techniques. The next generation of CMC tools will, however, provide such facilities and integrate multimedia technology and groupware with distributed conferencing and electronic mail, all within a graphical user interface.

Realization of the potential benefits of CMC requires institutions to develop a framework for course designers and students. Many of the first and second generation experiments were technology driven, with

insufficient foundation in the curriculum, making it difficult for students to perceive the real benefits. The success of the British Open University experiments with CMC owes much to an institutional Home Computing Policy, applicable to all undergraduate, graduate, and post-experience courses. The policy establishes the minimum student equipment requirements for successive five-year periods and spells out the level of support to be provided by the institution. The result is that students feel more confident about investing in personal computers and the institution is saved the cost of equipment provision. Institutions without such a policy are tackling the problems in a piecemeal fashion.

Institutions must also come to terms with the personnel issues. So far, few have addressed the question of rewards, either by way of salary increases or promotion and tenure, for faculty who commit their time and effort to CMC. Training and support is also required to overcome the discomfort expressed by faculty at the institution's expectation to adopt new technologies.

CMC delivery invariably results in a shift in costs for institutions. The traditional industrial model is associated with high capital costs offset by low recurrent costs. The CMC model tends towards lower capital costs per course but greater recurrent costs as a result of ongoing participation by faculty. It is therefore essential to exploit the potential for greater use of bought-in components (books, offprints, etc.) so as to provide cost savings which can support teaching and counseling by CMC. The role of faculty will also change from that of course authors to facilitators and personal advisers. And there will be a shift in control from teacher and teaching materials to the processes generated by the course participants. The teacher's role will be to moderate and track the processes evolving throughout the duration of a course.

The numerous studies cited in this review illustrate the enormous potential of CMC for distance education as well as some of the difficulties of implementation. Rarely is technology cited as a limiting factor. Nevertheless, there are limits to the technology available at any instant, and choices have to be made and problems overcome. However, the choices should be based on educational criteria; the latest technology serves no purpose if it is inaccessible to users. CMC presents an enormous challenge to teachers, who will have to learn new skills and new modes of delivery, but it should be seen as a challenge that can also be exciting, fun, and personally rewarding.

Nick W. Heap
Open University
United Kingdom

ACKNOWLEDGEMENTS

The author wishes to express very special thanks to Nick W. Heap, Course Team Chair of the Open University's DT200, for his valuable critique of this work. Heartfelt appreciation also goes to Bob Spencer, Matthew Rapaport, and Judith and Charles Van Duren for their comments on the final draft of this document. However, sole responsibility for content and errors of omission or commission rests with the author.

Computer-Mediated Communication for Distance Education: An International Review of Design, Teaching, and Institutional Issues

Rosalie Wells

Introduction

One of the most recent technological systems to be adopted for use in distance education is computer-mediated communication (CMC), which typically includes computer conferencing, electronic mail, and electronic bulletin boards. CMC is a means to establish an electronic environment that is accessible to participants who might otherwise be separated by time zones and physical distance. Students and an instructor use their personal computers and modems to connect to a central host computer that is running a conferencing software program. Participants have twenty-four hour access to the host computer and can dial in to receive or to leave messages for other participants. More than one person can be logged on at the same time (synchronous), but typically the communication is asynchronous. A student can engage in individual communication with another student or the instructor or participate in group projects with other distance students. For books on educational applications of CMC, see Harasim 1990b; Harasim in press; Harasim et al. in press; Mason in press b; Mason and Kaye 1989; O'Malley in press; Training Agency 1989; Waggoner 1992. For CMC bibliographies, see Burge 1992; Harasim 1990a; Wells 1991a.

In a matter of only a few years, CMC has been implemented within a wide range of educational settings:

1. In distance teaching universities, sometimes on an industrial scale, e.g., 1,364 students in the British Open University (OU) course titled DT200: Introduction to Information Technology;

2. In bimodal institutions, e.g., the New Jersey Institute of Technology (NJIT) and the New York Institute of Technology (NYIT);

3. In graduate programs offered at a distance, both established, e.g., Connected Education and Nova University (both in the U.S.), Deakin University (Australia), Télé-Université du Quebec (Canada), and newly approved, e.g., Athabasca University (Canada);

4. In institutions where CMC courses provide students with a distance alternative to face-to-face instruction, e.g., the Ontario Institute for Studies in Education (OISE);

5. In traditional institutions where CMC is used as an optional form of communication with classroom instructors, e.g., University of Guelph (Canada) and Lancaster University (U.K.);

6. In projects linking individual classes of elementary, junior high and high school students from various countries, e.g., Intercultural Learning Network and National Geographic Kids Network; and

7. In community education programs, e.g., National Public Telecomputing Network (Cleveland Free Net), Big Sky Telegraph (U.S.), and Nordic Telecottages.

Some of the primary reasons for utilizing CMC are to: provide students with opportunities for convenient course-related or social interaction with peers (Gunawardena, Gittinger, and Dvorak 1991; Kaye 1991; Rasmussen 1991); enable collaborative group work by distance students (Davie and Wells 1991; Kaye 1987; Marttunen 1991); facilitate interaction with an instructor (Ingesman 1991; Rekkedal and Paulsen 1990; Smith 1990); decrease turnaround time for instructor feedback (Gledhill and Dudley 1988; Misanchuk 1989); allow students access to online resources, e.g., databases, library catalogs, and course registration (Davie 1987; Kaye 1991; Teles and Duxbury 1991; Thompson 1991); and enable students to upload and download assignments and take online quizzes and tests (Kaye 1987; Misanchuk 1989).

Scope and Purpose of Review

The literature on CMC is as distributed as the implementations. Material cited in this review was found in internal reports, conference proceedings, as well as in books and journals pertaining to education, psychology, technology, computers, and communication. Some of the most recent literature was received in response to a request for material that was posted, then re-posted on networks and bulletin boards around the world by supportive colleagues.

Most publications on CMC are either: discussions of the relevant hardware, software, or communication networks (See Dvorak and Anis 1990; Glossbrenner 1983; Rapaport 1991; Quarterman 1989); general descriptions of the medium; case studies with varying levels of detail; or projected applications within educational and corporate institutions. This review focuses on empirical studies regarding the use of CMC in education, and in particular, distance education.

The purpose of this review is twofold: 1) It is intended to provide teachers, researchers, and administrators with a practical summary of current knowledge regarding design, teaching, and institutional issues in the use of CMC for distance education. A question and answer format is used both to emphasize the practical focus and to assist readers in locating specific information in a timely fashion and 2) This review seeks to consolidate the major questions and issues, thereby providing a relatively comprehensive overview of the field at this point in time.

The review is divided into four parts. Parts One, Two, and Three focus on Design, Teaching, and Institutional Issues. (It is important to note that CMC in education is a complex web of highly interrelated issues. To some extent, placement of issues in one section or another is an artificial process. For example, the part on *design* issues will be relevant to anyone who wishes to *teach* with the medium. Furthermore, a phenomenon like participation rates is influenced both by course designers and instructors who are moderating discussions.) Part Four consists of charts of selected educational and communications implementations which emphasize the extent to which CMC has become an international phenomenon.

PART ONE:

Designing a Course to Maximize the Potential of CMC

What types of course content are most appropriate for CMC?

One way to discuss the range of subject matter appropriate for use with CMC is to examine what courses have already been taught using the medium. While an exhaustive list is beyond the scope of this review, CMC has been included in a broad range of subjects at both undergraduate (Table 1) and graduate (Table 2) academic levels.

These tables illustrate the wide range of subject areas that have been taught at both the undergraduate and graduate levels using this medium. In general, the potential of CMC might best be realized in courses involving: discussion, brainstorming, problem-solving, (Feenberg 1987; Thomas 1989b), collaborative work (Harasim 1989; Kaye 1987); and reflective contributions which might be based on special preparation or research (Feenberg 1991; Manninen 1991). New software developments in the areas of computer graphics, simulations, and Digital Video Interactive should further increase the range of courses that might be effectively taught with CMC. (See Alexander and Lincoln 1989; Van Duren 1989.)

Table 1. Undergraduate Subject Areas

Content Area	Institution	Source
Computer science	Open University	Mason 1989a
	NKI (Norway)	Paulsen 1989
	NKS (Norway)	Søby 1990
	Dutch Open University	Meurs & Bouhuijs 1989
	Rochester Institute of Technology	Bissell et al. 1987
Foreign language labs	University of Arizona	Smith 1990
Group performance skills	Pennsylvania State University	Phillips, Santoro, & Kuehn 1988
History	Rochester Institute of Technology	Bissell et al. 1987
Humanities (archaeology)	Jutland Open University (Denmark)	Lorentsen 1989b
Physics (special relativity)	University of West Florida	Smith 1988
Probability and statistics	Royal Danish School of Ed. Studies	Larsen & Malmberg 1991

Table 2. Graduate Subject Areas

Content Area	Institution	Source
Computer science	Nova University (Master's and Doctorate)	Scigliano, Joslyn, & Levin 1989
	Brisbane College of Advanced Ed. (Diploma)	Scriven 1988
Education	OISE	Davie 1988; Harasim 1986
Distance education	Deakin University (Certificate, Diploma, Master's)	Thompson 1991
	Athabasca University (Master's approved January, 1992)	
Engineer training	U.S. Army Research Institute	Hahn et al. 1991
Management	Lancaster University	Hardy et al. 1991
Media studies	Connected Education (Master's)	Levinson 1989

In what ways can CMC be used in a course?

CMC might be used as an *option*, a *replacement* (i.e., for face-to-face tutorials), or as the *primary teaching medium* (i.e., an *online course*). These alternatives represent a continuum of usage ranging from the strictly voluntary to mandatory, where CMC is *integral* to a course so that students simply cannot succeed without using the medium (Feenberg and Bellman 1990; Lorentsen 1989a).

The decision of how to use CMC is inextricably linked to issues concerning: student access to computers and technical support, the allocation of teaching staff, and the computing resources of an institution. See Part Three for a more detailed treatment of these issues.

Is there a relationship between how CMC is used in a course and student participation rates? What are some considerations in deciding how integral CMC will be to a course?

Participation rates are not necessarily an issue if CMC is being used as an option. Participation rates might become important, however, if CMC is being used as either a replacement or as the primary teaching medium. Because CMC is relatively new, most attempts to implement it in

educational settings have entailed adding it to already existing course materials rather than revising course structure and content. Generally, CMC becomes more integral to a course as the course is written or rewritten for the medium. While it is difficult to generalize findings across the educational settings cited earlier, results from various case studies indicate that student participation rates are influenced by whether usage of CMC is voluntary or mandatory.

Generally, voluntary usage is likely to result in low usage, whether the participants are students or tutors. For example, the OU examined *tutors'* voluntary usage of CMC for communication, mutual support, and the exchange of information. The medium went largely unused, with tutors acknowledging that they would be motivated to use it only when required to do so (Mason 1987).

Similar results have been obtained with *students* at the OU (Mason 1987), the Dutch Open University (DOu) (Meurs and Bouhuijs 1989), NKI (Paulsen 1989), and the U.S. Army Research Institute (ARI) (Hahn et al. 1991). Students in the studies by the OU, the DOu, and NKI were all undergraduates, while participants in the ARI study were engineers working at the graduate level. In these cases where student-to-student interaction was encouraged but not required (either in the form of a mandatory number of messages per week or formal group work), strictly voluntary usage was considerably lower than course designers had anticipated.

Several factors can *interact* with voluntary usage, including:

1. Educational level: Senior level and graduate students might be regular even intensive contributors compared to the more sporadic or read-only level of many undergraduates (McCreary and Van Duren 1987). This does not suggest that CMC is inappropriate for less senior educational levels, only that additional care must be taken in designing these courses to ensure sufficient student motivation.

2. Time intensive: Results from several evaluations suggest that the administrative tasks related to computer usage are sometimes underestimated (Hahn et al. 1991; Meurs and Bouhuijs 1989). Depending upon the software, participants might be subjected to lengthy logon procedures and time-consuming down-loading and printing of information. Students new to both distance education and CMC might face particular challenges (Hardy et al. 1991). Some institutions are attempting to streamline CMC software both to simplify such processes for students and to minimize communication costs. See Part Three for more information.

3. Model of participation: Students socialized to independent study at a distance might need a model of *interactive* distance education which shows them that the benefits of peer interaction can justify the additional time demands of CMC (Bang and Møller 1990; Mason 1989b). (See Kling 1991 for an online course syllabus that suggests types of comments that students might make.)

What steps can be taken to encourage use of the medium?

Ways to encourage use of CMC have included: requiring a minimum number of messages per week (Hahn et al. 1991; Harasim 1987b; Smith 1990); ensuring that important information (such

as quiz questions and answers or instructor responses to questions) is only accessible through the computer (Hiltz, Shapiro, and Ringsted 1990); basing a certain percentage of the final grade on the content of the messages (McCreary and Van Duren 1987); assigning group work (Davie and Wells 1991); and actually converting or rewriting paper-based correspondence materials for CMC (Hahn et al. 1990, 1991; Harasim 1987b).

Can CMC support group work at a distance?

CMC's ability to support groupwork is often touted as one of its most remarkable and unique contributions to education (Davie and Wells 1991; Harasim 1989; Kaye 1987; O'Malley in press). It is therefore ironic that reported case studies of groupwork should form such a comparatively small part of the CMC literature, although it is important to note that there might be a substantial gap between what teachers are actively doing and what they take time to publish.

Available literature falls into two categories, intra-class and inter-class working groups. *Intra-class* collaboration includes small groups of students from the *same class* who are instructed to work together on an assignment, e.g. the collaborative writing assignments in the ENFI Project (Batson 1988; Batson et al. 1991). (For more information on the use of CMC to support collaborative writing, see Hartman et al. 1991; Owen 1989; Peyton 1989; Peyton, Scully, and Parker 1991.) Graduate education courses at OISE sometimes use the following types of groups: plenary and small group seminars, online working groups of five to eight students, team debates (Harasim 1989), and learning partnerships composed of two students (Davie 1988).

Inter-class groups represent almost revolutionary forms of collaboration that could not readily be sustained by any other form of instructional technology. These groups engage in *class-to-class* communication across time zones and often across cultures and continents. Examples of such projects include the Intercultural Learning Network (Levin, Kim, and Riel 1990; Riel 1987), the National Geographic Kids Network (Newman et al. 1989), the National Public Telecomputing Network (Kinnaman 1991a, 1991b), the RAPPI Project (Hart 1987), and Project Orillas (Sayers and Brown 1987). In these projects, students in one class use a computer, modem, communications software, and various combinations of networks to interact with students in classes that might be located across town or around the world.

These projects are remarkable for both the age of student participants and the range of projects. Students have ranged in age from elementary (Hart 1987) to middle, high school, and university levels (Chonacky 1991; Levin et al. 1987). Such projects have demonstrated that students of all ages can successfully engage in work supported by CMC, given sufficient teacher planning and an appropriate level of computer support.

These projects have also expanded the range of subjects that have been successfully delivered via CMC. Cross-cultural collaboration has occurred across a wide spectrum of subject areas, including: social sciences (Butler and Jobe 1987), natural sciences (Levin et al. 1989; Levin and Cohen 1985), geography (Rogers et al. 1990), foreign language literacy (Cohen and Miyake 1986; Sayers and Brown 1987), as well as creative and technical writing (Riel 1985).

The capacity of CMC to support group work might be one of CMC's greatest contributions to education. In particular, cross-cultural collaborations might even change the face of distance education, for these interactions represent a fundamental synthesis of face-to-face and distance instruction, as classes collaborate on projects with their distant peers.

What types of pacing techniques are available with CMC?

Group assignments are one way to pace CMC students, because they must be on schedule in order to make contributions to their group (Hahn et al. 1991; Hiltz 1986). A second pacing technique is gating, a process by which students are allowed access to material only when the prerequisites have been completed. This capability may help preserve the sequence of materials envisioned by course designers and reduce information overload for the CMC novice (Vallee et al. 1975). A third pacing technique is allowing students computer access to certain activities for a limited period of time, a procedure which is also an unobtrusive method of encouraging frequent logons. For example, a professor at NJIT scheduled readings and discussion questions that could only be accessed during the first half of the week, while an online quiz was only available during the second half (Hiltz, Shapiro, and Ringsted 1990). (For information on gating techniques in self-development education, see Johnson-Lenz and Johnson-Lenz 1990.)

What are some considerations in establishing enrollment limits on a CMC class?

In face-to-face instruction where class discussion is a priority, it is important to find some balance between a group small enough to encourage initial comments and large enough to sustain an ongoing discussion. However, this same issue is even more prominent in CMC. An insufficient critical mass of active students can mean there are relatively few messages to read or respond to (Hiltz and Turoff 1978). In establishing enrollment limits, it is important to note that the real class size is often much smaller in CMC than the enrollment figures would indicate. For example, research suggests that a minority of members (10%) can account for up to 50% of the messages. In fact, between 20–25% of the students in a class can be "lurkers," i.e., readers but not writers (Hiltz 1984). However, increasing class size simply for the sake of critical mass can result in a

class large enough to pose excessive time demands on instructors where other responsibilities are concerned, e.g., grading papers. Appropriate design and teaching techniques will typically be more effective ways to ensure a critical mass than merely increasing enrollment.

What is an appropriate size for a CMC class?

Twenty-five is a fairly recurrent figure in the rather small number of reported case studies of CMC classes. For example, a Norwegian undergraduate course had a main conference of one hundred students, one professor, and four tutors. However, there were four smaller "classes," each with twenty-five students (Søby 1990). A pilot course offered by the DOu used two tutors for sixty students (Meurs and Bouhuijs 1989).

For the OU's 1988 presentation of DT200, all 1,364 students had the option to participate in the national conference, but only twenty-five or so students participated in each of the sixty-five tutor groups (Mason 1989b). As a result, the actual group size was more commensurate with that of a traditional class than the numbers first suggest. However, an evaluation of this course revealed that the small tutor conferences sometimes lacked a critical mass of participants, while the number of messages in the national conference was often so overwhelming that many students were intimidated. As a result, a regional conference with approximately three hundred students, one "super tutor," and twelve tutors, has since become the primary forum for course discussion. These regional conferences have a sufficiently critical mass to be self-sustaining but not intimidating (Mason 1990b).

There are trade-offs to be made in setting the class size of a CMC course. As with face-to-face classes, institutions will seek to maintain high class numbers in order to maximize their return on instructors' time. And it is important to have a sufficiently large class to ensure a critical mass for discussion. A limited number of case studies suggests that approximately twenty-five students for a graduate or professional class might be large enough to sustain high rates of discussion; undergraduate classes, particularly with first-time users, might want to set higher enrollment limits, perhaps closer to sixty students.

Are there pedagogical uses of the computer transcript?

The presence of a permanent transcript is a feature that distinguishes CMC from classroom instruction as well as all other forms of educational technology. The transcript is a complete record of class proceedings that is automatically maintained by the conferencing software and available to

all class members. Unfortunately, there is almost a complete dearth of published information regarding its educational and administrative value (Davie and Wells 1991). Its pedagogical value might lie in the following areas:

1. An instructor's explanation given to an individual student becomes available to all class members (McCreary and Van Duren 1987) and can be stored in a database of answers that can potentially make teaching successive versions of the same course less time-consuming (Paulsen and Rekkedal 1990).

2. By preserving the entirety of a course's public interactions, the transcript is more complete than students' notes could ever be. As a result, the transcript provides students with a more complete and accurate basis for later reflection and study (Davie and Wells 1991).

3. The transcript might serve as the basis for evaluating individual and group performance, i.e., did the student meet the requirement of a specified number of logons per week? What were the relative contributions of group members? However, a transcript might be less helpful in large working groups, where the value of various contributions might be more difficult to determine (Harasim 1988).

4. A transcript might also be the basis of an assignment. Students might be asked to analyze it in a number of ways, including group dynamics, philosophical or ethical positions of the participants, and the evolution of an individual's positions during the course.

For administrative purposes, the transcript might be used to determine whether or not consistent standards are maintained among instructors, students, and courses. It might also provide one way to evaluate instructor performance, reward exemplary performance, and provide corrective feedback when necessary.

Some Suggestions for Further Research

- The implications of the use of CMC's asynchronicity and text-based communication on course design;

- The implications of forthcoming graphics-based systems on CMC course design;

- Ways to design courses that do not merely replicate face-to-face instruction, but which constitute new and unique types of educational experiences. For example, CMC software can support *parallel* discussions of course themes, which might be an exciting alternative to the *linear* presentation characteristic of classroom instruction (Quinn et al. 1983; Smith 1988);

- Pedagogical uses of a transcript;

- How to design groupwork using CMC. The collaborative learning literature should be relevant to this issue (e.g. Sharan 1980; Slavin 1980; Webb 1982, 1984);

- How participants actually work online, including their strategies for minimizing information overload. This information could affect how course material is structured and sequenced;

- How access to resources like online journals, discussion groups, and lists (Okerson 1992; Wilson 1991), online databases (Harry 1990), and research and cooperative networks (Kaye 1991; Quarterman and Hoskins 1986; Teles and Duxbury 1991) might enhance student learning; and

- How CMC might be used most effectively to support other media in a multi-media course.

PART TWO:

Teaching Considerations

How can CMC influence the type and range of instructional responsibilities?

Instructional workload might be affected by the following:

1. *Communication.* In a model like the regional and national conferences of the OU's DT200, tutors' interactions were not restricted to their own local tutor group of twenty-five students but could include any student in the class (Mason 1989a; Thomas 1989b). Tutor workload also increased at Jutland Open University (JOU) when CMC was used to supplement the standard five or six face-to-face meetings a year. While more continuous access to their tutor has enriched the educational experience for students, tutors' workload now includes CMC interaction as well as the intensive workload for seminar preparation (Christensen 1990).

2. *Feedback.* The fast turnaround time enabled by CMC can make it possible for an instructor to provide types of feedback hitherto difficult or impractical by surface mail or telephone: commenting on assignment drafts, advising on anticipated assignment problems, providing immediate assignment feedback (Thomas 1990). However, fast turnaround time depends upon the number of students in the class and the willingness of instructors to logon frequently throughout the week, a requirement that will have a decided affect on work patterns (Misanchuk 1989).

3. *Design.* New responsibilities might be assumed by instructors who choose to modify existing course packages to include groupwork and seminar discussion (Christensen 1990; Hahn et al. 1991).

4. *Computer support.* Any instructor who assumes the new task of trouble-shooting student computer problems will typically do so in addition to normal instructional responsibilities.

Some evidence suggests that while the instructional workload might be greatest during the first offering of a course (as in face-to-face), successive offerings might be *less* time-consuming because textual input by both students and instructors can be saved and re-entered in successive offerings (Paulsen and Rekkedal 1990). Other ways to help control instructor workload can be to: encourage peer learning both for its educational value as well as a means to redistribute certain instructional responsibilities (Mason 1989a); allow former students to become alumni, i.e., retain their logons and participation privileges in the course (Kaye 1990; Lewis 1991); broaden the range of contacts available to students, e.g., CMC enabled DT200 students to direct queries to course authors as well as to their tutors (Heap 1990; Thomas 1989b); divide the new instructional responsibilities between two individuals, one who has primary responsibility for course content and discussions while the other focuses on user training and support (Hahn et al. 1991; Harasim 1986; Phillips, Santoro, and Kuehn 1988). It might also be necessary to renegotiate tutor or instructor workload, at least temporarily (Mason 1989a).

What are some of the communication challenges students encounter in the CMC environment?

In their first exposure to CMC, many students might hesitate to contribute to discussions because of a fear of appearing unintelligent or exposing vulnerabilities. While this concern exists in face-to-face discussions, the situation in a CMC class might be more threatening because the software preserves a complete transcript of class proceedings that is always accessible to participants (Deutschman 1984; Hardy et al. 1991). This concern about public expression was evident in the pattern of interaction in a CMC course conducted by Harasim (1986). In the early stages of the course, students generated more personal messages than public conference items, a trend which reversed itself within two to three weeks. The anxiety about publishing disappeared as students became more comfortable with the medium. Effective ways to both encourage early responding and to socialize students to the medium might include assigning students to two-person learning partnerships (Harasim 1986), having "computer-experienced" students moderate some discussions (Rohfeld et al. 1991), and structuring early activities to stimulate brief direct input (Rohfeld et al. 1991).

Another problem students might face is the concurrent challenges of learning basic computer skills, new software, and appropriate online communication skills (Hardy et al. 1991). While students will use the technology if motivated to do so, they might need to be persuaded of the educational benefits of interaction (Bang and Møller 1990).

Another challenge students face concerns the impact CMC has on their study habits. Students will need to develop convenient stream-lined ways of interacting with the computer in order to minimize the time demands of CMC (Rasmussen 1991). For example, students at Syracuse University (U.S.) found it difficult to read messages on the screen so instead engaged in time-consuming downloading and printing prior to responding (Rohfeld et al. 1991). Research on the study habits of CMC students is necessary to provide feedback both to software designers and to instructors, who could provide students with efficient strategies for computer use.

What communication challenges do instructors face in the CMC environment?

It is not uncommon for instructors to find that the level of online discussions might be equal to or superior to those in face-to-face classes (Harasim 1987b; Marantz and England 1992; Smith 1988; Thomas 1989b, 1990). Reasons for this are primarily traceable to the asynchronicity of CMC, which allows students to: consult and incorporate outside resource materials into their response (Gledhill and Dudley 1988; Hiltz 1990); reflect at leisure before responding (Davie 1988; Davie and Wells 1991; Smith 1988); and participate anytime, twenty-four hours a day, seven days

a week (Harasim 1987a; Mason and Kaye 1990). In fact, the accessibility of the online environment can facilitate and sustain a level of intensity that is rarely achieved in face-to-face classes (Davie 1989). For example, a student in a Finnish CMC class observed that, "sometimes the discussion took me so totally that I came back to my office on evenings to see whether there are new messages, and my head was full of ideas. Discussion became a part of my life" (Manninen 1991, 84).

Encouraging and supporting active participation is one instructional challenge. Others include:

1. *Striking the right balance in feedback.* Without the immediate visual feedback most instructors are accustomed to, it might be difficult to know how directive or supportive one appears to be. In fact, tutors at Lancaster University found that it was often impossible to know whether students were interpreting feedback as supportive or critical. And attempts by tutors to be non-directive or deliberately quiet were sometimes interpreted as passivity or unavailability (Hardy et al. 1991). Similarly, Finnish trade union students often experienced the instructors' questions and suggestions for discussion as tests and felt an obligation to respond immediately (Manninen 1991).

2. *Fostering and sustaining student-to-student interaction.* Results from CMC courses at NKI (Rekkedal 1990) and Finland's University of Jyväskylä (Kalaja and Leppänen 1991) showed that student-to-student interaction was low, despite encouraging rates of student-instructor interaction; in fact, fully half the students in the NKI study neither sent nor received mail from other students (Rekkedal 1990).

3. *Diagnosing participation problems.* Students might frequently blame their low participation on frustrations with CMC, when the real problem might concern frustrations with the content or administration of the class (Hardy et al. 1991; Mason 1989a).

What teaching style is most effective for fostering participation in a CMC class?

Moderating a discussion in an educational computer conference can require an instructor to change teaching styles to function most effectively (Kaye 1989; Nipper 1989; Turoff 1990; Konttinen and Marttunen 1991; Teles and Duxbury 1991). In a CMC class, it might be appropriate for an instructor to pose questions instead of simply supplying answers, to learn when to remain silent, and to deflect an individual's requests for help to the group as a whole (thus encouraging student-to-student communication and peer learning). One major consequence of a shift to more facilitative behavior is that the instructor monopolizes less class time. For example, in a face-to-face class, an instructor might monopolize 60–80% of verbal interaction (Dunkin and Biddle 1974; McDonald and Elias 1976), while a CMC instructor might only contribute 10–15% (Harasim 1987a).

The influence of a *facilitative* style was illustrated in an early study which compared instructor and student behaviors during discussions in a CMC and a traditional classroom (Quinn et al. 1983). An evaluation disclosed that: the teacher in the CMC class directed half as many questions

to students as the instructor in the face-to-face class; a comment by the CMC teacher was often followed by several student responses, compared to the almost one to one ratio characteristic of the traditional class; students in the CMC class evaluated each other's comments with greater frequency than students in the face-to-face class. In short, shifting to a more facilitative teaching style can foster student-to-student interaction as well as encouraging more dynamic instructor-student interchanges.

In a CMC class, it might not only be appropriate but necessary for an instructor to delay a response in order to allow students to respond to the issue and to each other. While this suggestion seems to contradict the importance of immediate feedback, it does highlight some of the complexities in CMC. While a prompt response might generally increase student motivation and performance, it might subvert a computer conference by reducing it to glorified e-mail; too-frequent input by the instructor might reduce the responsibility students take for developing and preserving a true conference (Feenberg 1987; Smith 1988).

For further information on CMC moderating, see Brochet 1987; Feenberg 1986, 1989, 1991; Henri in press; Kerr 1986; Konttinen and Sajavaara 1990; Mason 1989a, 1991; Rasmussen 1991.

What are some examples of participation rates in CMC classes?

Students' rate of usage is probably the most frequently cited datum in case studies and not whether CMC has been used simply as a hotline for questions or as the primary teaching medium. Participation rates might vary as a function of students' self-selected rate of usage, how integral CMC is to the course, and teacher expectations of students. If CMC is being used primarily to facilitate student-instructor interaction, then high participation rates might be irrelevant. However, if CMC is being used to support a seminar discussion or group work, then participation rates might be one valid measure of a successful implementation. While these rates will vary across courses, instructors, and institutions, some examples might be helpful:

1. In a computer course at NKS, The Computer as a Tool, one hundred students produced approximately fifteen hundred written entries (Søby 1990).

2. In the nine month pilot course conducted by the DOu, fifty-three students wrote 1,037 messages, 486 of which were exchanged between two students (Meurs and Bouhuijs 1989).

3. In twelve-week graduate courses at OISE, thirty-eight participants generated 3,132 messages during one course, while twenty-nine students generated 3,177 in another (Harasim 1989).

4. In the certificate course, "Computing Tools for Management," offered by University of Victoria in Canada, twenty-four students wrote 183 messages during a three-month period (Muzio 1989).

5. In the first offering by the OU of DT200, more than 3,000 messages were entered in the national conference. Messages were accessible to all participants (1,364 students and 65 tutors). The sixty-five local tutor conferences generated over 4,500 messages (Thomas 1989b). (See Mason 1989a for a thorough examination of participation rates in this course.)

Various observations should be made concerning these participation rates. First, there is no reason to assume that the only students learning from the online interaction are the active participants. "Lurkers" might be learners, too. (Face-to-face classes also have their own form of "lurkers," i.e., listeners but not speakers).

Second, students new to the medium might benefit from clear specification of performance levels (McCreary and Van Duren 1987), i.e., requiring a minimum number of comments per week. However, it might be useful to specify that these required comments be content-related, otherwise students might satisfy this requirement with social comments entered in lounge or cafe conferences. While requiring a certain level of participation might seem to mitigate the freedom of adult learners, online participation might be the only way an instructor can assess a student's online *attendance*. (In a face-to-face classroom, an instructor can see who is present, even though attendance does not necessarily guarantee attention.)

The performance rates cited here provide some parameters for what a CMC discussion might look like. But as Mason (1989a) points out, what is almost uniformly missing is information about the actual *content* of these messages. Sheer *quantity* does not provide any information regarding the educational *quality* of the exchanges. This factor should receive greater attention in future studies. (For examples of ways to analyze online comments, see Boshier 1990; Brewer and Davis 1992; Brookshire 1991; Duranti 1986; Gunawardena, Gittinger, and Dvorak 1991; Levin, Kim, and Riel 1990; Mason in press a; Quinn et al. 1983; Riedl 1989.)

What information is available regarding the turnaround time in providing feedback in a CMC class?

CMC feedback lies on a continuum, ranging from the immediacy of face-to-face dialogue to the three week turnaround time characteristic of many distance teaching institutions (Kaye 1989). While data are limited, feedback within twenty-four hours was an expectation in the CMC courses conducted by the DOu (Meurs and Bouhuijs 1989) and ARI (Hahn et al. 1991). In the ARI CMC course, the full-time instructor provided feedback within twenty-four hours eighty percent of the time. In fact, most of the feedback occurred either within four hours of receipt of the message or between eight to sixteen hours. In a pilot study at the Royal Danish School of Educational Studies,

the turnaround time for feedback was often between one to two days, although same-day feedback occurred frequently (Larsen and Malmberg 1991).

While twenty-four hours might be a reasonable turnaround time for a full-time instructor, there might be occasions in the course when even twenty-four hours is too slow. Students might need even more prompt feedback in the case of gated material, i.e., required feedback from the instructor before the student can access other coursework. Otherwise, students might schedule a block of study time only to find themselves unable to proceed without instructor feedback (Hahn et al. 1991). In order to facilitate efficient progress through the course, instructors should consider the use of prerequisites and gated material only when absolutely necessary and the use of self-check exercises whenever possible (Hahn et al. 1991).

What are some ways to train faculty in online teaching?

Neither the challenges of online teaching nor the necessity of effective instructor training should be underestimated. The text-based asynchronous medium will require some changes, despite the fact that much of an instructor's expertise in face-to-face interaction or distance teaching will generalize well to the online environment. Indeed all staff associated with both the production and presentation of online courses might benefit from training in the medium, although studies by the OU (Thomas 1989a) and JOU (Christensen 1990) suggest that student training is typically given priority. An evaluation of CMC at JOU revealed that more resources were devoted to computer training for students than their instructors, with the result that students became proficient faster than their teachers. In addition, the importance of instructor training on *educational* issues in CMC was overlooked entirely (Christensen 1990).

CMC instructor training might occur through: manuals that include the differences between online and face-to-face interaction, a basic list of do's and don'ts, examples of online interactions, and analyses of basic communication problems and possible solutions (Feenberg 1991); establishment of a "faculty club" where CMC instructors can discuss administrative and pedagogical issues (Paulsen 1990a); establishment of a moderating conference for newcomers that is run by experienced teachers and is continuously available (Feenberg 1991); and allowing instructors access to each other's course conferences (Paulsen 1990a). (See Harbour et al. 1990 for an example of a training manual for CMC instructors.)

What are some specific examples of instructional techniques used in a CMC class?

While a comprehensive list of teaching techniques is beyond the scope of this work, the following are illustrative of the kinds of options an instructor might exercise.

- *Establishment of a pedagogical database.* An instructor might establish a database of answers that can be edited as necessary, then re-posted during the next course offering (Paulsen and Rekkedal 1990). This database might also include both model answers as well as representative faulty ones, additional exercises, literature references, supplementary material, and comments from earlier participants which can be inserted as appropriate into an ongoing class (Larsen and Malmberg 1991). Such a database might not only help reduce the time demands of successive offerings of a course, it can help enrich the educational experience of students.

  Previous course offerings might be archived and made accessible to students who can read transcripts of earlier offerings of the course, depending upon possible confidentiality issues. Access to earlier course offerings might greatly expand the range of "peers" from whom students might learn.

- *Establishment of specific conferences.* An instructor might establish two-person conferences with participation limited to the instructor and a single student. Feedback on homework and ongoing dialogue with individual students can be posted to this conference, which affords all the privacy of e-mail but with the conference's permanent record of all proceedings (Goodman 1987).

  One way to conduct online assessment and preserve test security is to post exams or quizzes to a closed conference, with one exam per conference. Students might be given access to this material by being assigned conference membership when they are ready (Goodman 1987).

  All assignments might be posted to a conference in order to maintain a permanent record of them. After the deadline for submission, an instructor might post model answers for the benefit of all students (Røyrvik, Dawes, and Harv 1991) or post students' papers (Davie 1987). In this way, students might learn from each others' answers, while the instructor saves time by sharing common feedback with the entire group.

  A conference might be established to note all modifications to the class schedule or curriculum (Røyrvik, Dawes, and Harv 1991). In this way, an instructor has the flexibility to make course changes without the time delays inherent in notifying students by surface mail.

  A separate conference might be established for ongoing discussions of specific hardware and software problems. Students might prove to be a welcome source of expertise, which might reduce but not eliminate the need for institutional support (Davie 1988; Heap 1990; Mason 1989a).

  In groupwork, information overload might result if an instructor tries to follow all events in every group's conference. One solution found by JOU was to have teacher and group "meet" twice a month in a special conference. At that time, students were responsible for summarizing their progress, problems, and the type of assistance they required from the instructor (Christensen 1990).

  The hierarchical organization of local, regional, and national conferences characteristic of the OU's DT200 (Mason 1990b) might be adapted by individual instructors. For example, several history instructors from either the same or different institutions could establish a common discussion conference for their classes. Such a conference could not only ensure a critical mass for discussion but also enrich students' educational experience by giving them access to their peers as well as other instructors.

- *Peer learning.* Having computer literate students moderate some discussions might help build the confidence of their less skilled classmates and encourage participation (Rohfeld et al. 1991).

  Giving interested students "alumni" status can be a valuable and economical way of fostering peer tutoring. For example, seventy students from the OU's 1988 offering of DT200 asked to keep their CoSy IDs so they could participate in successive offerings of the course (Kaye 1990).

Some Suggestions for Further Research

- Identification of effective teaching techniques in facilitating participation among different student populations.
- Identification of teaching styles that might facilitate types of interaction that are unique to the medium and which exploit possible differences between CMC and face-to-face interaction.
- Effective techniques for facilitating students' rapid adjustment to the text-based asynchronicity of CMC.
- How student behavior changes with experience both within and across CMC courses.
- Factors that affect whether a student is an active, intermittent, or inactive user.
- Effective training techniques for CMC instructors.
- Cost-effective ways for CMC faculty to structure their workload.

PART THREE:

Institutional Issues

Part Three is divided into two sections, "Computer Access" and "Marketing, Policy, and Cost." Institutional issues pertaining to computer access can be divided into various levels of access (Wells 1991b): access as ownership; access to an appropriate *configuration* of equipment; *convenient* access to a computer; access to computer literacy training (either face-to-face or at a distance) and to ongoing user support; and access by a cross-cultural population.

Section I: Computer Access

Is access to a computer a critical factor in successful performance in a CMC class?

Access to a computer is virtually a prerequisite for successful performance in a CMC course (Harasim 1986; Lorentsen 1989b; Hiltz 1990). In the many communication conferences conducted by the Institute for the Future, lack of convenient access to a computer was a major factor in non-starters and low usage by others (Vallee et al. 1974). Similarly, in a CMC study by Denmark's JOU, low usage was reported for students who had to use computers at local study centers, compared to other groups that had computers in their homes (Lorentsen 1989b).

Furthermore, Lorentsen found evidence of performance differences between students who had convenient access to computers at home or work, compared with students who had access only at study centers. The former tended to learn the system more quickly and to set the agenda for discussion. In contrast, study center students often logged on for the first time only to find an overwhelming number of contributions to a discussion they had not had an opportunity to help define. As a result, they were more likely to "lurk" than to become active participants (Lorentsen 1989b).

An anecdote drawn from an evaluation of a CMC class taught through the University of Alaska shows some of the hurdles that students might face when traveling to a computer site:

> The place you chose was full of smoke and nobody there knew how to operate a modem. Later I was told it was no longer hooked-up. Also, to use a modem I had to cross the bay in the skiff in rain, snow or 6-foot seas which does not seem consistent with outreach classes. (Fields and Ryan 1991, 2)

And while access to a computer at *work* would seem to spare students some problems, access on the job might be more minimal than it first appears (Hardy et al. 1991). Students might have

limited opportunity to work on the office computer because of their own work responsibilities, the presence of other people, and the availability of a terminal. Thus, students might be forced to either remain late to work on the computer or to return to the office on weekends, both of which can reasonably be expected to affect participation rates (Hardy et al. 1991).

A related problem is lack of access due to travel obligations associated with a job. In the ARI CMC study, students whose travel requirements cost them access to a computer found it difficult to make up the work (Hahn et al. 1991). One way to minimize this problem is to supply students with or encourage them to purchase portable computers. Some of the students in the Lancaster University study purchased laptops (Hardy et al. 1991), while portable computers were supplied to students in the *pilot* studies conducted by Canada's University of Waterloo (Black et al. 1988); Australia's Brisbane College of Advanced Education (Scriven 1988) and Macquarie University (Gledhill and Dudley 1988); and ARI (Hahn et al. 1991). Since portables are also sturdier, an institution which supplies computers to students should be able to minimize costs for damage due to shipping as well as to reduce the impact of hardware problems on students' performance.

What are some examples of current rates of access to computers?

Data regarding current rates of access are scattered. For example, in a 1988 survey, the OU determined that one third of its students had access to a microcomputer, and that of this group, over 18% had access to one at home (Kirkwood 1988). Male students were more likely than female students to have access to a microcomputer, with almost twice as many men as women having access to one at home. The percentage of students with convenient access was even higher among students at the DOu. In 1987, a survey had shown that 56% of DOu students had access to a microcomputer (36% at home and 20% with access to one elsewhere). Access was even higher among DOu science students, 81% of whom reported convenient access (Meurs and Bouhuijs 1989).

A recent survey by Athabasca University (AU) of a representative sample of 151 students showed that approximately 82% had access to a personal computer. Of this number, 46% reported access through ownership or lease; 5% had access to a microcomputer owned by a family member; 13% and 18%, respectively, reported access to a computer at a friend's or at the workplace. No gender differences in computer access were found (Conway 1991).

Rekkedal (1990) reported no differences in computer ownership between three groups of students: twenty-eight prospective students at NKI who requested course information in the spring of 1989, twenty-five EKKO (CMC) students, and thirty-six correspondence students already enrolled during that period (the return rate for questionnaires was 71%, 80%, and 72%, respectively). Almost 70% in each group owned their own computer and almost half of those

reporting ownership also had access to a computer at work. Approximately 25% had access to a computer at work, and only five students did not have any type of access to a computer.

With the declining costs of personal computers, it is reasonable to expect ever increasing numbers of students in developed countries to have access through ownership (Hardy et al. 1991). However, an institution should consider surveying current rates of computer access among its students prior to extensive exploration of CMC use in courses.

What are the options an institution has in facilitating student access to computers?

Since convenient access to a computer affects successful performance, institutions offering CMC courses have several options. The first is to supply computers to students, a procedure adopted in pilot studies at ARI (Hahn et al. 1991) and JOU (Bang and Møller 1990; Lorentsen 1989b). The NJIT issues computers to all in-coming freshmen (Hiltz 1990).

A second option is to place computers in local study centers (a procedure employed by JOU for half the students in the pilot study) (Bang and Møller 1990; Lorentsen 1989b). However, merely placing computers in a study center might not be enough. In order to justify the cost of travel, a study center must be a place where a student can work comfortably for several hours, a place somewhere between a laboratory and a library (Bang and Møller 1990). Providing students with comfortable well-designed study centers will have cost implications for an institution.

Most institutions, however, have chosen to require students to provide their own equipment. These include: Lancaster University (Hardy et al. 1991), Connected Education (Levinson 1989), Nova University (Scigliano, Joslyn, and Levin 1989), and the Electronic University (U.S.) (Osgood 1986). Prior to enrollment, thirty-five percent of the students at the Electronic University did not own a computer, but purchased one specifically for taking courses (Osgood 1986).

The 1988 offering of DT200 shows the range of options available to an institution for ensuring computer access. Of the 1,364 students who completed registration, one third made their own arrangements to secure access, slightly more than one fourth bought a computer using the special purchase price negotiated by the OU, while the remaining forty percent rented a machine for £150. This last group of students received financial support from the OU in the form of a tuition reduction from £150 to £100 (Thomas 1989a). Students also had the option to borrow a machine from the OU, but only for short periods of time and only in the event of hardware problems (Kirkwood 1989).

Another policy decision is whether to make computer/modem ownership a requirement for all students, a prerequisite for specific course enrollment (Kaye 1990; Kearsley and Lynch 1991), or for specific groups of students (Kaye 1990). Ten undergraduate courses at the OU require students to have access to a computer and printer at home, although DT200 is the only course with CMC as a built-in feature (Kaye 1991). The OU is considering expanding use of CMC to include: low-population specialist courses where an online seminar could be utilized; a number of courses in the

School of Management's MBA options; and support to the house-bound, the geographically remote, and those living overseas (Kaye 1990).

Institutions that plan to offer CMC courses should explore ways to ensure that their students have convenient access to a computer. Convenient access is in the interest of the students as well as the institution, which thereby ensures a market for its CMC courses. On the other hand, while requiring students to supply their own equipment might be the only way that institutions can offer CMC courses, the trade-off might be various problems associated with incompatible equipment (Heap 1990; Muzio 1989). These problems might be unavoidable, as an increasing number of people in industrialized nations acquire computers for various purposes, distance education being among those purposes.

Is there data regarding access by distance students to modems?

The DOu found that modems were still comparatively rare (no numbers reported), despite the fact that fifty-six percent of its students had access to a microcomputer (Meurs and Bouhuijs 1989). Similarly, a study by Brisbane College of Advanced Education showed that its students were more likely to have access to a microcomputer than to a modem; accordingly, the College rented modems to students in a pilot study (Scriven 1988).

In the AU study, roughly one third of the students' computers were equipped with modems, with 19% of students reporting some use of the computers for communication purposes (Conway 1991). Somewhat higher figures were reported by NKI. Fifty percent of their EKKO students had access to a modem at home, 30% had access at work, and 20% had access both at home and work. Among correspondence students, 28% had access to a modem, 20% only at work. Thirty-five percent of their prospective students had modem access, with 15% only at work (Rekkedal 1990).

Because modems are relatively inexpensive, they are likely to be financially accessible to most students. However, their comparative rarity suggests that many adult computer users will have little or no experience in the use of CMC. This inexperience will obligate universities to provide appropriate training materials and tutorials.

What are some of the factors influencing an institution's decision to require students to have access to a specific configuration of equipment? What types of configurations are being specified?

If an institution requires students to have access to a certain configuration of equipment in order to take a CMC course, it must first consider whether the configuration should reflect today's standard or what students can reasonably be expected to own in a couple of years. Second, it

should consider whether it will provide user support to only those students who have the specified configuration, or whether it will attempt to provide some level of support to all its student computer users. For example, survey results in the AU study showed that respondents' computers included twenty-seven different manufacturers, among them IBM (12%), Tandy (11%), and Apple (20%) (Conway 1991). Third, an institution should consider some special rental or purchase plan to encourage access by its students to any specified configuration.

There is some information available regarding what configuration is being used by a few institutions.

1. The WINIX CMC software developed by Norway's Trondheim College of Education requires at least type 286 machines with 1 MB RAM, although type 386 machines with at least 2 MB RAM are preferable (Rønning 1991).

2. The current home computing policy of the OU specifies an MS-DOS computer with 512kb of RAM (Thomas 1990), a twin-drive monochrome PC, a dot matrix printer, and a basic (1200/75, 300/300 baud) modem (Kaye 1991).

3. Students at NKI are not required to own any specific type of microcomputer, modem, or communication software, as long as they can upload and download ASCII files via EKKO (Paulsen and Rekkedal 1990).

4. In its pilot study, the U.S. Navy Postgraduate School (NPS) used portable laptop computers (640 kbytes of RAM, 20 Mbyte hard disk, 3.5 inch floppy disk, built-in 1200-baud modem) and a compact ALPS printer (Simpson and Pugh 1990).

What factors influence the quality of a student's access to a computer?

The issue of convenient access is somewhat more complicated than it first appears. *Quality* of access, particularly in the home, is an important factor affecting successful performance in a CMC course (Kirkwood 1988). For example, the location of the computer within the home might have an impact on performance (Hardy et al. 1991; Kirkwood 1988). For some students in the Lancaster University study, working in a quiet part of the home facilitated concentration, while it made other students feel isolated. Locating the computer in busier areas like the kitchen or living room helped a few students feel integrated into family activities, while other students either worried about disturbing family members or were resented by spouses for their visible course activities (Hardy et al. 1991). Thus, the location of the computer not only affects other individuals who might be present (if any), it might also have an impact on the time of day or which days of the week students are free to work at the computer (with obvious implications for communication costs) (Hardy et al. 1991).

Another aspect of convenient access at home pertains to how many members of the family use the computer. An OU survey revealed striking gender differences. Over fifty percent of female students reported frequent use of the computer by their husband, while only one twelfth of male students reported frequent use of the computer by their wives. In addition, more women than men reported frequent use of their computer by children (Kirkwood 1988). These findings suggest that the husband's machine is his, while the wife's machine is often the family's.

Other factors that can affect quality of access are whether the computer must be assembled and disassembled for use or whether there is convenient access to a telephone for modem use (Kirkwood 1988). Surveys of students in the CMC course implemented by the OU revealed that two thirds of the 1,364 students were able to leave their computer workstation set up permanently. However, one third of the students did not have permanent computer workstations (Mason 1989b).

What types of user support might students require?

User support for CMC can be divided into three categories: face-to-face training, training at a distance, and ongoing user support. The type and amount of user support will be affected by students' current level and type of expertise. For example, one sixth of the students in the OU's 1988 offering of DT200 had no previous experience with microcomputers; more than fifty percent had never received formal training on microcomputers or on electronic communication. Over half had experience with word processing, and more than one third had some experience with electronic mail (Thomas 1989a).

How long does it take participants to develop the necessary hardware and software skills to use CMC successfully?

The time required to develop basic CMC proficiency will vary as a function of the software, students, and course requirements. However, it might be useful to cite some of the reported estimates: two hours using LEARN, special CMC software developed by the Royal Danish School of Educational Studies (Larsen and Malmberg 1991); three to five hours on CoSy (Kaye 1987); five to ten hours on Participate (Harasim 1986); and one week on EIES (no hours reported) (Mills 1987).

However, these reports should be interpreted with caution, for they contain neither an operational definition of proficiency nor a detailed list of the operations their students were expected to perform. One of the more detailed case studies reports that NPS students were able to

unpack and set up their computer, receive, print, compose, and send a message within a couple of hours using CMC software specifically designed for distance students (Simpson and Pugh 1990).

Are face-to-face training meetings essential for successful performance in a CMC class?

One of the most persistent beliefs among CMC educators is that a successful class depends upon an organized face-to-face session prior to a period of computer communication only. Generally, the face-to-face meeting is designed to facilitate interpersonal interaction as well as the rapid acquisition of computer skills. Institutions which incorporate a face-to-face meeting prior to and sometimes during delivery of a CMC course include OISE (Davie 1988; Harasim 1987b), Nova University (Scigliano, Joslyn, and Levin 1989), the DOu (Meurs and Bouhuijs 1989), and the Western Behavioral Sciences Institute (WBSI) (Feenberg 1987).

However, it is important to emphasize that few if any studies have experimentally compared CMC courses delivered with and without a face-to-face component, so it is difficult to know whether a face-to-face meeting is essential or merely desirable in certain contexts. Indeed, various organizations and institutions have successfully offered CMC courses that consisted exclusively of online interaction. These include NKI (Paulsen 1987/1988), ARI (Hahn et al. 1991), Connected Education (Levinson 1989), the University of Victoria (Muzio 1989), and the OU (Mason 1990b). Institutions should explore various techniques that would enable students to study not only the course content but also the computer skills at a distance because face-to-face meetings can place travel, time, and financial constraints upon students.

What options does an institution have to provide participants with access to computer training at a distance?

Because the rapid acquisition of computer skills is perhaps the primary reason for most face-to-face sessions, it is important to note that there are ways to teach these skills at a distance. Print-based is probably the basic type of training material. (See Ohler 1991 for an example of a CMC user manual and Harbour et al. 1990 for an instructor training manual). Paper-based training can include information regarding protocols for the telecommunications software, sign-on and system procedures, as well as online etiquette (Rohfeld et al. 1991). It is important to present the technical material in stages, so that participants are not overwhelmed with information for which they might have no immediate use (Hardy et al. 1991).

Audio cassettes were designed by the OU to talk students through various computer procedures required in the DT200 course (Mason 1990b), while videotapes might also be helpful for system setup and other types of training (Fields and Ryan 1991).

The Canadian Medical Association and Telecom Canada used a synchronous audio-teleconference and dataconference to train physicians at a distance in the use of online retrieval systems (Marshall 1987). In the training session, the physicians logged on to iNet. At this point, the audio link allowed them to listen to the instructor discuss computer procedures, while the computer link (after entry of a special command) allowed them to simultaneously watch the contents of the instructor's computer screen on a monitor at their site.

Another alternative is to offer students face-to-face training at a community site. For example, a CMC project at the University of Alaska attempted to use community expertise, i.e., a local businessman, a high school computer teacher (Fields and Ryan 1991). While there are obvious challenges in coordination and supervision, this idea could be useful in certain circumstances.

What types of ongoing support might be required by CMC participants?

While information on this point is sketchy, there is some evidence that a telephone hotline might be extremely useful to students, particularly at the *beginning* of a course (Larsen and Malmberg 1991; Simpson and Pugh 1990). Hotlines have been used by: ARI (Hahn et al. 1991); the NPS (Simpson and Pugh 1990), the Royal Danish School of Educational Studies (Larsen and Malmberg 1991), and the University of Waterloo (Black et al. 1988). While few studies provide a break-down of technical support, the evaluation of the NPS CMC course listed ongoing technical support used by ten students: software engineer, one to two hours a week; hotline support, thirty minutes a week; and from the computer center, thirty minutes a week (Simpson and Pugh 1990).

The type and amount of ongoing user support that is required is influenced by several other factors. The first is whether or not user support will be provided for every type and configuration of computer, modems, communication software, etc. that students already own (Hardy et al. 1991; Heap 1990). A second issue is that students might require technical assistance outside of normal work hours. For example, for students in the DT200 course, Sunday was typically the most active day while 8:00–11:00 PM was usually the busiest time (Thomas 1990). Periods of student activity might not only be influenced by the cheaper telephone rates for evening and weekend calling (Thomas 1990) but by students' daytime employment schedules (Hahn et al. 1991).

In general, it is important to remember that "Every system is harder to use than those who select it imagine, and many participants will drop out rather than report problems, yet will welcome help if it is volunteered" (Feenberg 1991, 99).

How can software modifications or developments affect the need for user support?

Development of a front-end for the conferencing software might reduce the need for face-to-face training or technical support by streamlining and automating the logon procedure. Front-ends for CoSy were developed by both the OU (Kaye 1990; Thomas 1990) and the NKI College of Engineering (Røyrvik, Dawes, and Harv 1991). The OU front-end overlays both Kermit and the command line interface of CoSy itself (Thomas 1990) and provides a simple menu and a set of 'hands-on' tutorials (Mason 1990b). Front-ends were developed by ARI for Confer II (Phelps et al. 1991), NKS for PortaCOM (Søby 1990), and by WBSI for VAX Notes (Feenberg 1991).

Many institutions are developing their own CMC software for distance students, in contrast to using existing conferencing software designed for generic communication purposes. In general, CMC software designed specifically for distance students often attempts to minimize expensive communication charges by automatically connecting to a mainframe, downloading all new files and messages, then hanging up (Fjuk and Jenssen 1991; Kaye 1991; Simpson and Pugh 1990). See Table 3 for a list of some institutions developing CMC software.

For discussions of design considerations for CMC software in distance study, see Alexander 1991; Feenberg 1986, 1991; Feenberg and Bellman 1990; Fjuk and Jenssen 1991; Goodrum and Knuth 1991; Hiltz and Turoff 1985; Johnson-Lenz and Johnson-Lenz 1991; Kaye 1991; Olsen 1991; Palme 1991a, 1991b; Quale 1990; Schmitt 1991; Simpson and Pugh 1990; Thompson 1991; Turoff 1991. See Greenberg 1991; Greif 1988 for issues pertaining to groupware design.

To what extent can CMC support cross-cultural student membership in classes?

One of the most exciting potentials of CMC is also a reality, access to online courses by a cross-cultural group of students. Both Connected Education (Levinson 1989) and Nova University (Scigliano, Joslyn, and Levin 1989), for example, offer online classes that are taken by students from a range of countries. In some cases, however, student computer access, technical expertise and common languages might be necessary but not sufficient conditions. Varying degrees of economic prosperity will make it difficult for students in some countries to take online courses offered from other countries. For example, for many Central European students, the tuition fees for an online course in the U.S. might be half the cost of their annual income (B. Pecha, personal communication with the author, July 1991). Institutions and organizations seeking a cross-cultural student population in their online programs might need to consider special scholarship arrangements for some students. (See Bates 1989 for a discussion of other issues in cross-cultural distance education.)

Table 3. Institutions Developing CMC Software

Institution	Software	Source
Deakin University (Australia)	CBTS	Thompson 1991
Jutland Open University and Aarhus Technical College (Denmark)	RelaCs	Andersen 1991; Bandholm 1990
Macquarie University (Australia)	Electronic Tutorial	Gledhill and Dudley 1988
NKI (Norway)	EKKO	Paulsen 1989
Open University (U.K.)	Thought Box	Alexander and Lincoln 1989
Royal Danish School of Educational Studies (Denmark)	LEARN	Larsen and Malmberg 1991
Thomas Edison State College (U.S.A.)	CALL Network	Seaton 1989
Trondheim College of Education (Norway)	WINIX	Rønning 1991
University of Waterloo (Canada)	Gemini	Cowan and Stepien (n.d.)
U.S. Navy Personnel Research and Development Center (U.S.A.)	Instructional Support Network	Simpson and Pugh 1990

Section II: Marketing, Policy, and Cost

For marketing purposes, what information is available regarding the reasons students take CMC courses?

While information on this point is scattered and can be expected to vary across institutions and countries, it might be useful to note some of the findings and expectations. For example, Thomas (1989b) suggests that CMC courses in any subject area will be more attractive to students with access to computers and experience in online communication or students able to purchase a computer.

However, survey results of graduate students at Lancaster University showed that a major reason students took the course was to overcome their "technophobia" in a supportive academic environment (Hardy et al. 1991). Similarly, survey results from NKI found that the two major

reasons students took CMC courses were the subject and the communication medium (Paulsen and Rekkedal 1990). Additional data from NKI showed that students who chose CMC courses had more experience with correspondence study than students who chose to study with correspondence only. This finding suggests that students confident of their ability to succeed in traditional correspondence study might welcome challenging new forms of distance education (Rekkedal 1990), a possibility with obvious marketing implications.

What are some of the policy decisions that an institution might have to make if it chooses to use CMC in some of its courses?

Computing services and support. Some of the considerations for implementing CMC systems will include:

1. What kind of host/operating system should be used? Will existing equipment be adequate or should new equipment be purchased or leased (Paulsen 1990b)?
2. What kind of conferencing software, e-mail, or bulletin board should be purchased (Cruz 1991; Paulsen 1990b)?
3. What levels of access within the software should users be provided (i.e., read-only) (Paulsen 1990b)?
4. What communication network should be chosen (Heap 1989; Paulsen 1990b)?
5. Will the institution specify a particular configuration of equipment?
6. Will it support all makes and models of computers and modems?
7. What types and amount of user support will the institution provide (Lorentsen 1989a)?
8. If computing services have been primarily responsible for servicing the university's *administrative* offices, what steps will be necessary to make the shift to online *teaching,* which reaches a much wider and more public audience (Feenberg 1991)? (It is important to note that CMC pilot studies might supply valuable data on usage patterns, data that might be used to predict the demands on an institution's computing resources) (Misanchuk 1989; Teles and Duxbury 1991).

Course-related issues.

1. Should courses continue to be offered in the traditional way as well as through CMC, to avoid excluding students who cannot gain access to a computer?
2. How will course workloads be adapted if CMC is added to a course, particularly if it is integral? For example, if CMC is added to a course and the original workload remains unchanged, then students are doing more work for the same credit.

Instructional staff issues.

1. Depending upon how CMC is used in a course, there will be more, less, or merely different instructor responsibilities. In cases of increased workload, what steps might an institution take to either redistribute workload or to increase salary (Mason 1989a)?

2. Will an institution *supply* CMC instructors with computers, user friendly software, and training (Birchall and Wilson 1989)?

3. What steps will an institution take to encourage and recruit instructors who are willing to use CMC? What criteria will it use to select instructional staff (Birchall and Wilson 1989)? (See Castro 1987 for survey results of instructors at Deakin University regarding their attitudes toward CMC.)

What information is available regarding the costs of CMC to participants and to the institution? Can an institution save money by using CMC?

It is important to note that the cost of CMC will depend upon how it is implemented: as an option, a replacement, or as the primary teaching medium (Phelps et al. 1991). A course in which CMC is an integral component will cost more in instructor time, for example, than one in which CMC is used as a replacement for a telephone hotline. A second factor is *who* pays for *which* costs, e.g., one way an institution can save money is to shift costs to students. Third, an institution might find that CMC courses do not necessarily cost less, they just cost differently. *Production* costs might be reduced while *presentation* costs increase (Rumble 1989; Thomas 1989a, 1989b, 1990). A fourth factor affecting cost is whether or not an institution already has a computer infrastructure in place that is capable of supporting online classes (Rumble 1989). While full review of this complex issue is beyond the scope of this paper, the following are examples of cost considerations:

1. Depending upon how CMC is implemented, an instructor might be able to manage more students in an online than in a face-to-face class (Thomas 1989a). Tutors in DT200 were paid the same amount for their online time as they were for eight hours of face-to-face instruction (£139). Based upon the evidence of DT200, Thomas (1990) estimates that one or two members of the instructional staff could manage conferences with two hundred or more participants. Furthermore, the peer learning enabled by CMC is also one way to help economize on instructor time since students now have dozens, and maybe several hundred potential sources of assistance (Mason 1989a; Thomas 1990).

2. CMC could reduce or eliminate the need for many of the specially prepared teaching materials characteristic of distance teaching institutions like the OU (Rumble 1989; Thomas 1989a, 1990); a CMC discussion could now be used to help bind course components together (Thomas 1990).

3. In its potential for eliminating the need for face-to-face instruction, CMC can also eliminate the travel costs incurred by instructors and students (Hahn et al. 1991; Thomas 1989a; Larsen and Malmberg 1991). However, this savings could be offset by the communication costs of CMC.

4. Instructional staff (central academics and tutors), as well as relevant support staff, will need to learn either the practical skills of CMC, the instructional skills, or both (Thomas 1989a; 1990). In its 1988 offering of DT200, the OU was more successful at providing equipment and training for students than for its own central academic and support staff (Thomas 1989a).

5. Will an institution supply instructors with machines or require them to supply their own? Open University tutors who supplied their own equipment received a "nominal" reimbursement from the University (Thomas 1990).

6. At institutions where the cost-effectiveness of distance education is well-established, adding a CMC component without increasing tuition costs will require a fundamental rethinking of all the course components (Kaye 1989; Phelps et al. 1991; Rumble 1989). In fact, the fullest exploitation of the potential of CMC for distance education might entail the conversion and redesign of course materials, a step taken by both the DOu (Meurs and Bouhuijs 1989) and ARI (Hahn et al. 1990).

7. It is possible that CMC could actually enable an institution to increase its market, either by reaching new groups of students or by using new developments, like computer simulations, to expand the range of courses and majors it can offer at a distance (Phelps et al. 1991).

8. There are suggestions that CMC might help improve course presentation (Rumble 1989) and contribute to the ease and frequency of course revision (Rumble 1989; Thomas 1989b), thereby reducing the possibility of offering out-dated courses (Phelps et al. 1991).

What information is available regarding who pays the communication costs of CMC, the institution or the student?

Relatively few case studies provide information on this point. The OU, for example, required the student to pay the communication costs, which depended upon a student's geographic distance from a local dial-in node. Approximately sixty percent of students in DT200 lived within local call access of the OU's Academic Computing Service. For these students, the off-peak charge was 50p per hour; however, about fifteen percent of students faced charges that were eight times as much (Thomas 1989a). After its initial pilot study, Henley Management College shifted communications costs to the students (Birchall and Wilson, 1989). Originally, CMC students at NKI paid exactly the same course fees as the correspondence students (Paulsen 1990a). Now, however, the CMC students pay a term fee, which covers communication costs, independent of their courseload, approximately $150 (U.S.) (Paulsen 1992).

Depending upon the geographic distribution of its students, an institution should consider ways to minimize the differential long distance telephone charges incurred when students dial the

university's computer. Furthermore, requiring a high level of participation might be an economical disadvantage to those students who are most distant, and who might most need the benefits offered by the medium. This factor had a major impact on the OU's decision to keep the CMC component in DT200 at a fairly minimal level (Mason 1990b).

Some Suggestions for Further Research

- The most important characteristics of user friendly software, from the users' point of view, particularly software that allows users to work offline to minimize communication costs and to archive and easily retrieve material in a variety of ways;
- The most equitable ways to equalize telecommunication costs from the students' perspective;
- The most effective ways to provide computer training to various user groups at a distance;
- The relative cost-effectiveness of various types of user support;
- The cost-effectiveness of CMC for different types of implementations; and
- Identification of the most effective options for facilitating convenient access to computers, from the students' perspective.

PART FOUR:

Charts

The purpose of Part Four is to provide an overview of the range of CMC implementations internationally. Entries in the charts were primarily gleaned from the available literature and represent only a small sample of existing implementations. Even so, they emphasize:

- A range of educational, governmental, and corporate institutions using CMC;
- A surprising amount of CMC activity in developing countries;
- A range of collaborative efforts supported by CMC, many of them cross-cultural; and
- Types of community and social activist implementations.

A Selection of Educational Uses of CMC

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
Aarhaus Technical College	Denmark	Using PortaCOM to support distance learners
American Productivity Center	Houston, Texas U.S.A.	Using CMC to present seminars on productivity issues to high-level executives
Apple's Global Education Network	More than 70 schools from 22 countries participate	International telecommunications network supports cross-cultural collaboration; one project linked students in Eskimo and Arab Schools
Association of European Correspondence Schools		Offers continuing professional education courses in distance education; either a certificate or diploma can be earned, depending upon the amount of study
Athabasca University	Athabasca, Alberta Canada	Master's in Distance Education will use CMC for course delivery
AT&T–Canada	Toronto, Ontario Canada	Worked with Athabasca University and the Canadian government to establish the Canadian Distance Learning Association (one project: software development for CMC)
AT&T–LDLN (Long Distance Learning Network)	275 users in U.S.A., the Netherlands, Australia, Germany, Japan, Canada, Israel	Created to study instructional networking; participants include students and teachers from elementary and secondary, undergraduate and graduate institutions
Austra-USA Project	Australia/U.S.A.	Goal of this telecommunications project is the exchange of letters, poetry, reports on local culture, and news between schools
BESTNET	Network of universities in southwestern U.S.A. and Mexico	CMC supports instructor-student interactions

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
Big Sky Telegraph	Montana, U.S.A.	A BBS providing a wide range of low cost services, online instruction, and online expertise
Birbeck College	U.K.	Has recently begun offering some CMC courses
Birmingham University	U.K.	As of 1986, NOTEPAD was being used on an experimental basis
Boise State University	Boise, Idaho U.S.A.	In the Fall of 1989, BSU began offering a Master's degree in Instructional Technology using CMC
Bowling Green University	Ohio, U.S.A.	E-mail used in a graduate course on New Media Research
BreadNet	Washington, D.C. U.S.A.	Network links teachers, students and associates of Middlebury College's Bread Loaf Program; activities focus on writing, literature, and theater
Brisbane College of Advanced Education	Queensland, Australia	CMC used to teach Graduate Diploma of Computer Ed. courses
California State University	Long Beach, California U.S.A.	CMC used in some undergraduate and graduate business classes
Cambridge University	U.K.	Began installation of a network linking computers supplied to all staff and students
Campus 2000	U.K.	A consolidation of Prestel Education and the Times Network for Schools
CECOMM (Centre for Electronic Communications and Open Support Systems in Education)	U.K.	Sponsored a course to 34 participants on educational applications of CMC
Centre for the Study of Management Learning, Lancaster University	Lancaster, England	Experimented with the use of CMC for group and tutorial work between residential meetings
Clemson University	Clemson, South Carolina U.S.A.	CMC used to track the problems of university computer users, to maintain a database of past problems, and notify users of solutions

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
Cleveland Free-Net	U.S.A., with international gateways	Supported by National Public Telecomputing Network, the Free-Net provides a wide range of educational and community interest options
Connected Education ("Connect Ed")	U.S.A.	Non-credit online workshops, undergraduate and graduate courses; an online Master's is available in Media Studies; proposed doctorate
Contact North/Contact Nord	Ontario, Canada	CMC is used to supplement print and audio packages in distance delivery to residents of northern Ontario
Correspondence School	Sydney, Australia	Explored the use of e-mail to reduce turnaround time in providing feedback on assignments; target population: 7-year olds studying at a distance
Deakin University	Geelong, Australia	E-mail and an electronic bulletin board are used in Deakin's Master's in Distance Education Program
DEUCE (DELTA Electronic University for the Citizens of Europe)		Recently proposed by the European Commission
DoDDS (Department of Defense Dependents Schools)	U.S.A.	International telecommunication projects include simulations, distance learning, and staff development
Durham College of Applied Arts and Technology	Ontario, Canada	Experimenting with CMC for delivering computer courses at a distance
Dutch Open University	The Netherlands	Experimented with an information science course taught via e-mail
Earth Lab	New York, New York U.S.A.	A local area computer network designed to support collaborative work among sixth grade students and teachers (researched by Bank Street College and BBN Laboratories)

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
Electronic University	Norway	Cooperating with the Electronic University (San Francisco) to offer classes from 16 universities in the U.S.A.
Electronic University	San Francisco, California U.S.A.	Offers more than 150 electronic courses from colleges and universities
Electronic University Network	U.S.A.	Various universities offer credit and noncredit courses through the network
Empire State College	New York State U.S.A.	Evaluated the use of CMC in the delivery of a course, Contemporary American Diplomacy
ENAN	U.S.A.	Educational Native American Network
EuroPACE	Europe	A cooperative project between businesses and universities that distributes educational programs on technology by satellite, supported by CMC
Fielding Institute	Santa Barbara, California, U.S.A.	Used for student support, communication with faculty, and administrative matters
FrEdMail	U.S.A., Argentina, Puerto Rico, Australia, Argentina	Teachers, administrators, and students participate in large groups with open admission or smaller groups by request
George Washington University	Washington, D.C. U.S.A.	A BBS has been used by faculty and students in the Educational Technology Leadership Program
Hawaii Global TELEclass Program	University of Hawaii U.S.A.	Uses CMC, audio teleconferencing, and slow scan television to link high school students in cooperative learning projects
Henley Management College	Henley on Thames, U.K.	CMC used to provide students with an electronic classroom as well as quicker feedback
Houston Community College	Houston, Texas U.S.A.	Offers a series of "modem classes"

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
Indiana University	Bloomington, Indiana U.S.A.	Studied the use of CMC for collaborative learning and large lecture classes
IRIS	U.S.A.	An educational network supporting teacher development, student projects, and e-mail
ITT Dialcom System	Ohio State University U.S.A.	Used e-mail in a pilot study of an adult and vocational education program; 16 sites studied over a three-month period in 1983
Jutland Open University (JOU)	Denmark	Starting in 1988, JOU began PICNIC (Project in Computer Networks in Distance Education Curricula)
Kids Network	U.S.A.	Four thousand children at 200 sites participated in a project involving data collection on acid rain; funded by National Geographic, the National Science Foundation, and Apple Computer
McGill University	Montreal, Quebec Canada	In 1987, McGill offered a course to a group of Baffin Island teachers; in 1988, a computer science course was offered to teachers in the Gaspe, northern Quebec, and the Northwest Territories
McGraw-Hill Information Exchange System	U.S.A.	Received approval from the USSR to include its Pioneer Palace School students in international computer conferencing nets; also has various computer conferences available by subscription
McGraw-Hill Mix	2,000 subscribers in U.S.A., Mexico, Canada, Puerto Rico, Japan	60–70 conferences for teachers and school administrators
Merit Network	Michigan, U.S.A.	Longest running statewide computer network in the U.S.A.

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
Michigan State University	East Lansing, Michigan U.S.A.	Experimenting with the use of CMC for off-campus nursing students
Montgomery College: Extended Learning Services	Rockville, Maryland U.S.A.	Offering 1 course each in Health and American History using CMC
National Technological University (NTU)	Colorado, U.S.A.	Faculty interact with students by telephone, e-mail, and teleconferencing
National University Teleconference Network (NUTN)	U.S.A.	Formed in 1982 by 66 universities and the Smithsonian; offers courses to national audiences (e-mail support)
New Jersey Institute of Technology	U.S.A.	Offers some classes entirely by CMC; some face-to-face classes use CMC as one mode of interaction
New School for Social Research	New York , New York U.S.A.	Offered their first course via conferencing in Oct. 1985; by spring 1986, the number of courses was increased to 10
New York Institute of Technology	U.S.A.	Uses CMC in many courses offered by its distance learning program, The American Open University of NYIT
NKI	Norway	Developed their own software, EKKO, in 1986; have 5 years experience with computer conferencing in distance education
NKS	Norway	Used PortaCOM to teach a computer course; expanded offerings planned for fall 1989
Northwestern University	U.S.A.	Students in a large lecture class on political science had e-mail access to the professor for questions/comments
Nova University	Ft. Lauderdale, Florida U.S.A.	Offers several master's and doctoral programs in computer-related fields using online instruction

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
NY/Moscow Telecommunications Project	U.S.A./U.S.S.R.	The project connects 10 schools each in New York and the U.S.S.R.; the focus is on problem-solving, particularly in math and science
Ontario Institute for Studies in Education	Toronto, Ontario Canada	Some graduate courses taught using this medium
Open University	Milton Keynes, U.K.	CMC was first used in a class with 1364 students; planning for possible upper division and more lower division use, as well as use by the Open Business School within its MBA program
Pennsylvania State University	University Park, Pennsylvania, U.S.A.	Three graduate courses in distance education use CMC in conjunction with students participating in Mexico and Finland as well as throughout Pennsylvania
Pitzer College	U.S.A	Used as an adjunct to two face-to-face classes; Introduction to Linguistics and Computers as Tools
Project Orillas	Mexico, Argentina, Puerto Rico, U.S.A.	Goal is to promote Spanish language literacy for bilingual and foreign language students
Riverdale Collegiate Institute	Toronto, Ontario Canada	Conducts "Writer in Electronic Residence" projects linking elementary and secondary students in Canada, Iceland, Finland, and Israel
Royal Danish School for Educational Studies	Denmark	Experimenting with the use of CMC in teacher training; developed CMC software, LEARN
SchoolLink		Uses science and social studies projects to create global classrooms
Simon Fraser University	British Columbia Canada	A science course to be delivered with CMC is in the development stages; delivered an education course with e-mail in fall 1985

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
South Australian College of Advanced Education	Australia	Offers a Graduate Diploma in Distance Education
Star Schools Project	Japan, West Germany, Italy,the U.S.S.R., and the Virgin Islands	Classes share the results of math and science projects focusing on radon, weather, and polling; conducted by TERC under a Department of Education grant
State University of New York	Albany, New York U.S.A.	Uses conferencing to support faculty and student work
Syracuse University	Syracuse, New York U.S.A.	PARTI will be used to field test CMC for delivery of a course, Community and Adult Education; conducted a short conference between students at Syracuse and the Universities of Twente (Holland)
Télé-Université	Quebec, Canada	Is planning to introduce a CMC component into some of its courses on computing and information technology
The Pluto Project	Europe	Purpose is to explore curricular applications of CMC; classes in different countries will gather and share data on weather, pollution in rivers, etc.
Thomas A. Edison State College	New Jersey, U.S.A.	The Call Network is used to deliver many online courses and to provide access to college services
TWICS	Japan	An international net operated in cooperation with a private English language school; information is primarily entered in English but some is delivered in Japanese
University of California	San Diego, California U.S.A.	Multiple experiments on various aspects of CMC with children and college students
University of Guelph	Guelph, Ontario Canada	Developed CoSy, one of the leading CMC software packages

ORGANIZATION	LOCATION	IMPLEMENTATION (Courses)
University of Michigan, School of Education	U.S.A.	High school students in the U.S.A. use CMC to role play scenarios of current political and socioeconomic importance
University of Paris-Dauphine	France	CMC is used in some courses
University of Phoenix	Phoenix, Arizona U.S.A.	Using CMC to offer graduate and undergraduate business degrees
University of Quebec	Quebec, Canada	Runs a publicly available database and bulletin board service which has an e-mail component
University of Saskatchewan	Saskatoon, Saskatchewan, Canada	Used for assignment submission in a Sociology 110 course
University of Strathclyde	U.K.	Graduate students established a conference on "New Publishing Ventures"; the conference proceedings were published as an electronic journal
University of Victoria	Victoria, British Columbia Canada	Used for student-instructor and student-student interaction in the Certificate Program in Computer-Based Information Systems
University of the Virgin Islands	St. Thomas/St. Croix	CMC will be used to "import" faculty and educational resources from a mainland university (planned)
University of the World	La Jolla, California U.S.A.	An international educational and research net designed to connect universities around the world

A Selection of Communication Uses of CMC

ORGANIZATION	LOCATION	COMMUNICATION
AARNET	Australia	The national academic and research network
ACSNET	Australia	Its purpose is to connect research, academic, and industry users
AOLIN (Australian Open Learning Information Network)	More than 50 Australian and overseas organizations	Purpose is to promote educational networking through e-mail
Arkleton Trust	Scotland	Used in various local research efforts
ARPANET	U.S.A.	Named after DARPA (Defense Advanced Research Projects Agency); facilitates research sharing and collaboration; also a testbed for new developments in networking; begun in 1969
Athabasca University	Athabasca, Alberta Canada	Used primarily for internal communication
AUSEAnet	Australia, Thailand, Indonesia, Malaysia, Singapore, Brunei, and the Philippines	The metanetwork for a joint microelectronics project among ASEAN (Association for South East Asian) countries and Australia
BERNET	Germany	A research network in Germany
BitNet (Because It's Time NETwork) (recently renamed CREN)	Begun in the U.S.A. in 1981; other constituents now include Canada's NetNorth, Europe's EARN, and Japan's AsiaNet	Used by academics and researchers for professional communication (links 350 mainframes at over 100 U.S.A. institutions)
BLEND (Birmingham and Loughborough Electronic Network Development)	U.K.	Purpose was to study the problems in establishing electronic communities of computer specialists, psychologists, ergonomists, library schools, and the Guild of Airline Pilots and Navigators

ORGANIZATION	LOCATION	COMMUNICATION
Boeing Computer Services	U.S.A.	Conferencing used to support a company-wide technology transfer program
BOSTID (Board on Science and Technology for International Development)	U.S.A. and some African nations	Panelists, staff, and advisors are using CoSy for professional discussions on African economic development; the conference will expand as more African participants join
Boston Museum of Science	Boston, Massachusetts U.S.A.	Two groups of teenagers in Boston and Geneva, Switzerland played a conflict resolution game, The Other Side
BYTE Magazine	U.S.A.	Uses CoSy for its information exchange (BIX)
California State Assembly	U.S.A.	A subcommittee has established a computer network to allow constituents input concerning telecommunications legislation
CANADANET (CDNNET)	Canada	Effort to establish a nationwide net for Canadian researchers
Canadian Union of Public Employees	Canada	Developed SoliNet for bargaining support, grievance tracking, support for strikes and research, and journalism (labor news available online)
CDNnet	Canada	Used by Canadian educators, as well as those engaged in research and development
Chatback	U.K.	Free electronic mail service for children with speech or hearing impairments
Chiefs of Police	U.S.A.	A computer net links police chiefs with criminal justice researchers and other experts in law enforcement

ORGANIZATION	LOCATION	COMMUNICATION
CHIMO	Mississauga, Ontario Canada	Network managed by the Peel Board of Education for teachers and students in the region and beyond
CHYMNET	U.S.A.	CONFER is used to connect high school and college chemistry teachers, both nationally and locally
COGNET	U.S.A.	A network for scientists in linguistics and psychology
CompuServe	U.S.A.	In addition to conferences and e-mail communication, subscribers have online access to an Associated Press news service, airline reservations, home shopping, banking services, and games
COMSEC	Originally New Jersey; now extended to out-of-state participants, U.S.A.	This teachers' net facilitates the sharing of common concerns, resources, and ideas
Continental Bank	U.S.A.	More than 1,000 employees are linked by e-mail
COSAC (Communications Sans Connections)	France	A French research network begun in 1981
COSTEL (Course System for Telecommunicated Training and Innovation Management)		CMC is used to link 35 partners from 9 different countries; project develops common training material at a European level which is tailorable to national needs
Cote d' Ivoire	Africa	IBM-Europe is funding a link from the Cote d' Ivoire to the European EARN network
CPPNW (Canadian Physicians for the Prevention of Nuclear War)	Canada	Uses CoSy for information-sharing and social activism
CRAT/ARCT (African Regional Centre for Technology)	Senegal	Has established a food technology network initially linking five institutions in Cameroon, Morocco, Nigeria, Senegal, and Kenya

ORGANIZATION	LOCATION	COMMUNICATION
CSNet	U.S.A./Canada, with links to Australia, France, Germany, Israel, Japan, Korea, Sweden, and the U.K.	A network for computer scientists and those engaged in advanced science and engineering; began in 1981 with funding from the National Science Foundation
DETN (Distance Education and Training Chapter of NSPI)	U.S.A.	Chapter of the National Society for Performance and Instruction; CMC is used for communication and networking
DFN (Deutsches Forschungsnetz)	Germany	Used by academics and researchers for professional communication
Digital Equipment Corporation (DEC)	U.S.A.	Designing both hardware and software for CMC; currently, 50,000 DEC personnel participate in over 4,000 informal conferences; maintains an internal engineering network called EasyNet
DISC (Disabled Information Services of Canada)	Canada	Network for the exchange of ideas, articles, and messages
DRENET	Canada	A military network similar to and linked to ARPANET
EARN	Europe	The European Academic Research Network, linking over 100 mainframe computers and 100 institutions in 18 countries
EcoNet		Facilitates communication among an international membership of ecologists
EDAN	Ontario, Canada	Pilot project funded by TV Ontario to establish conferences for organizations, educators, and students
EUnet	Originally linked the U.K., the Netherlands, Denmark, and Sweden	The European UNIX network; purpose is to provide users with electronic communications and online news

ORGANIZATION	LOCATION	COMMUNICATION
EuroCOM	Europe	Used by dispersed communities of scientists and information workers (available to participants in the EEC ESPIRIT program)
EXXON	U.S.A.	EXNET links 240 organizational development specialists around the world
GCOM Gaeltachta Authority	Ireland	CoSy translated into Gaelic; used to preserve and teach the Gaelic language
Gemological Institute of America	California U.S.A.	Online training in gemology
GENET	U.S.A.	A network for geneticists
Geshernet	Israel	CMC links Israeli participants with the international Jewish community
GlasNet	U.S.S.R.	Named after Glasnost, this net proved an important communication link during the August, 1991 coup attempt
GreenNet	Based in London U.K.	Serves a range of progressive organizations in Western Europe
Greenpeace		CMC connects 400 professionals around the world
Harvard University Educational Technology Center	Boston, Massachusetts U.S.A.	Ran a network for 75 secondary science teachers in Massachusetts
Hewlett-Packard	U.S.A.	Conferencing used by engineering and marketing units for information sharing and project management
Institute for the Future	Menlo Park, California U.S.A.	One of the earliest and most creative users of CMC; conducted considerable empirical research
Institute of Nuclear Power Operators	U.S.A.	Notepad is used to connect each utility with consultants, vendors, and other relevant organizations

ORGANIZATION	LOCATION	COMMUNICATION
Instrument Society of America	U.S.A.	Used conferencing to develop standards
International Council for Distance Education	Oslo, Norway	Plans to establish computer networks to connect its regional organizations
International Development Research Center	Ottawa, Ontario Canada	Held an open 8 month online conference with more than 100 researchers from various countries
International Energy Agency	Labs in Sweden, Austria, Canada, the U.S.A., and New Zealand	A bioenergy project used COSY
IPPNW (International Physicians for the Prevention of Nuclear War)		CMC used to facilitate communication between busy professionals in geographically dispersed regions; active on PeaceNet
International Research Cooperation	U.S.A. and Soviet Union	Joint research venture on the uses of computers in education
JANET (Joint Academic Network)	U.K.	Designed to connect universities and research institutions in the U.K. and to provide them access to international nets
Janus	Europe	Proposed two-way voice and data communication link between European institutions to facilitate jointly produced distance teaching materials
JEDEC committee of IEEE (Joint Electron Device Engineering Council)	U.S.A.	Used conferencing to develop standards for a new integrated circuit
Johnson's Wax	U.S.A.	Uses conferencing for information exchange among 160 marketing managers around the world
JUNET	Japan	As of 1986, the major nationwide non-commercial computer network for both research and cooperative exchange among users

ORGANIZATION	LOCATION	COMMUNICATION
KUON-TV (PBS station)	University of Nebraska, Lincoln, Nebraska, U.S.A.	Managing 15 conferences exploring uses of new technologies for PBS stations
MARIS-NET	U.K.	A database of open learning materials available in the U.K.
MARYNET	Maryland, U.S.A.	Serves as an informal resource exchange for educators, students, and parents interested in educational applications of microcomputers
MFENET	U.S.A.	Connects physicists doing research in nuclear fusion, particularly in Magnetic Fusion Energy (MFE)
MILNET	U.S.A.	A production military network
Ministry of Natural Resources	Toronto, Ontario Canada	Uses CMC to distribute updated information on water conservation
NetNorth	Canada	Links 90 host computers at 20 Canadian universities and research sites; connects to BitNet and EARN
New York Institute of Technology	U.S.A.	Conferences used to connect teachers, Teacher Resource Centers, and to facilitate grant writing and publishing
New York Youth Network	New York, New York U.S.A.	Social service and educational networking by primarily black and Hispanic youth
NSFNET	U.S.A.	Supported by the National Science Foundation; the net is used to access supercomputers, libraries, and satellite data, as well as to link researchers and scholars
NITEC Network (National Information Technology in Education Centre)	Ireland	The network is designed to facilitate professional collaboration and the introduction of information technologies into local schools

ORGANIZATION	LOCATION	COMMUNICATION
NORDUNET		A system linking all the national research networks; funded by the Nordic Research Council
OCEAN	U.S.A.	A network for oceanographers
Office of Educational Communications of the Association of Atlantic Universities	Halifax, Nova Scotia Canada	Studied communication patterns of two interuniversity computer nets in Canada (Netnorth/Bitnet and CDNnet)
Online Journal of Distance Education and Communication	University of Alaska U.S.A.	A "publication" which is only available online
Ontario Institute for in Education	Toronto, Ontario Canada	Uses its own Online Studies Educators Network; Coordinates a Latin American Educational Research Network
Open Learning Agency	Vancouver, British Columbia Canada	Used to connect 250 tutors; all should be online within two years
PeaceNet		Facilitates communication among an international membership
PEN (Public Electronic Network)	Santa Monica, California U.S.A.	Provides BBS and computer conferences on local issues, e.g., rent control, recycling, the homeless
Pennsylvania State University DEOSNEWS and DEOS-L	University Park, Pennsylvania, U.S.A.	DEOSNEWS is an international electronic journal for distance education with participants in 40 countries; DEOS-L was established to facilitate discussion and to disseminate information about distance education issues
Pilnet (Personal Information Living Network)	U.K.	Thirty regular contributors will evaluate: a) the impact of information technologies on public access to information (including implications for training); b) value of an electronic net for inter-institutional research cooperation

ORGANIZATION	LOCATION	COMMUNICATION
PROFF (Nordic Programme for Postgraduate Education in Media Communication via Computer Conference)		Sixty professors and doctoral students at 29 Nordic institutions are using CMC to share research ideas and to network professionally
Project CUE	Canada	Seeking ways to make CMC accessible to those currently disenfranchised; exploring cost-effective ways of linking regional networks to national and international nets
PROPHET	U.S.A.	A network for medical researchers
PTL-Telematics	Helsinki, Finland	(like Bell Telephone, only in Finland); plans to have commercial CMC service
Public Electronic Network (PEN)	Santa Monica, California U.S.A.	Provides residents with e-mail access to city offices
Queens Overall Economic Development Corporation	New York, New York U.S.A.	Uses conferencing to provide businesses with information regarding sources of financing and new market options
RAPPI Project		Host varies on an annual basis; connects 75 schools across Canada and Europe
Rochester Institute of Technology	Rochester, New York U.S.A.	Uses CMC for purposes of communication and instructional delivery
ROSE (Research Open Systems for Europe)	Europe	(In progress) Goal is to provide a network infrastructure for collaborative research and development within ESPRIT (the European Strategic Program in Information Technology) of the European Economic Commission (EEC)
Rurtel Network	Scotland	Used by rural groups for management activities, to increase access to services, and improve educational quality and access

ORGANIZATION	LOCATION	COMMUNICATION
SCIENCEnet	U.S.A.	An interdisciplinary net for scientists
SDN	Korea	Purpose is to facilitate computer communications and resource sharing, as well as to provide a test environment for research and development
SeniorNet	U.S.A. and Canada	As of 1989, over 2,000 older adults were active on the network which facilitates information access, self-help activities, social interaction, and political activism
Simon Fraser University	Burnaby, British Columbia Canada	Uses Forum for faculty networking and teacher training
SkolCOM	Sweden	A new conferencing system piloted for teachers and teacher trainees; purpose is to facilitate communication regarding educational development and information technologies
SPAN (Space Physics Analysis Network)	U.S.A./Europe	Begun in 1980, SPAN is used by researchers in Solar Terrestrial and Interplanetary Physics, as well as for data comparison and collaboration between NASA and the European Space Agency
Sulawesi Regional Development Project	Indonesia/Canada	CMC used to maintain daily contact between Indonesian and Canadian staff
SUPERNET	Europe	Universities and industries from 6 European countries participate in this computer network for distance teaching; goals are market development and refinement of distance teaching methods
Surfnet	The Netherlands	The Dutch national research network

ORGANIZATION	LOCATION	COMMUNICATION
Syracuse University	Syracuse, New York U.S.A.	Conducts several topical discussions on a net; graduate students in adult education have an electronic journal; SeniorNet connects seniors and provides access to some services
Telecottages	Denmark, Sweden, Norway	Networks of "electronic village halls" facilitating self-help and community management
TELENET	U.S.A.	Public data network
Télé-Université	Montreal, Quebec Canada	Used for internal communication; also translating CoSy into French
Texas Instruments	U.S.A.-based	More than 8,000 terminals in their worldwide network; 4 million messages annually
The Source	U.S.A.	In addition to conferences and e-mail communication, subscribers have online access to United Press International, business and financial news, and home shopping
Toshiba	Tokyo, Japan	CMC is used for project management
TYMNET	U.S.A.	Public data network
United Nations University (Tokyo) and the International Development Research Centre (Ottawa)		CMC used to connect Latin American and Canadian scientists engaged in Brucellosis research
University of Arizona	U.S.A.	Used in approximately 35% of the administrative units on campus (with over 400 users)
University of Maryland	Baltimore, Maryland, U.S.A.	Used CoSy to connect community-based pharmacists with the pharmacy faculty
University of Regina	Regina, Saskatchewan Canada	Recently installed MLNET, the basis of a local electronic network

ORGANIZATION	LOCATION	COMMUNICATION
U.S. Army	U.S.A.	The Army maintains over 1500 user IDs and runs about 3 dozen conferences
U.S. House of Representatives	Washington, D.C. U.S.A.	Subcommittee on Science and Technology and a group of scientists used conferencing to discuss the development of a national science policy
VNET	U.S.A.; nodes also found in North and South America, Africa, the Middle East, Europe, Australia, and Asia	IBM's company network
Welsh National Library	Wales	Used to plan a genetics conference; CMC is also used to facilitate communication between authors and publishers
White House Conference on Library and Information Science	Washington, D.C. U.S.A.	Conferencing was used to plan this 1978-1979 conference
White House Conference on Productivity	Washington, D.C. U.S.A.	In 1983, 200 executive vice-presidents from Fortune 500 companies, 60 CEOs and several major labor unions used CMC to plan for the conference

REFERENCES

Alexander, G. 1991. *Towards an Open Conference System.* Open University: Milton Keynes, U.K.

Alexander, G. and C. Lincoln. 1989. The thought box: A computer-based communication system for distance learning. In *Mindweave: Communication, Computers, and Distance Education,* eds. R. Mason and A. Kaye, 86–100. Oxford: Pergamon Press.

Andersen, K. 1991. Distance education at University of Aarhaus. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon,* eds. A. Fjuk and A. E. Jenssen, 77–79. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Bandholm, A. 1990. *RelaCS: Design Principles.* Aarhaus, Denmark: Aarhaus Technical College.

Bang, J., and M. Møller. 1990. Computer conferencing in Danish distance education. In *Media and Technology in European Distance Education,* ed. A. W. Bates, 249–52. Milton Keynes, U.K.: European Association of Distance Teaching Universities.

Bates, A. W. 1989. *Towards a European Electronic University: Technology and Course Design for European-wide Distance Education Courses.* Heerlen, The Netherlands: European Association of Distance Teaching Universities.

Batson, T. 1988. The ENFI Project: A networked classroom approach to writing instruction. *Academic Computing* 2(5):32–33, 55–56.

Batson, T., J. Peyton, T. Collins, M. Spitzer, C. Neuwirth, and D. Thompson. 1991. *Final Report of the ENFI Project: Computer Networks and the Writing Classroom.* Washington, D.C.: The Gallaudet ENFI Project.

Birchall, D. W. and L. Wilson. 1989. Interaction versus independence: The dilemmas in designing a computer mediated communications student support system. In *Interaction and Independence: Student Support in Distance Education and Open Learning,* ed. A. Tait, 25–35. Cambridge: International Council for Distance Education and the British Open University Regional Academic Services.

Bissell, S. A., N. R. Coombs, D. J. Medvedeff, and S. M. Rogers. 1987. Distance teaching techniques using electronic conferencing. In *Proceedings of the Second Guelph Symposium on Computer Conferencing,* 3–9. Guelph, Ontario: University of Guelph.

Black, J. P., D. D. Cowan, V. A. Dyck, S. L. Fenton, C. K. Knapper, and T. M. Stepien. 1988. Portable computers and distance education. In *Developing Distance Education,* eds. D. Sewart and J. S. Daniel, 107–11. Oslo: International Council for Distance Education.

Boshier, R. 1990. Socio-psychological factors in electronic networking. *International Journal of Lifelong Education* 9(1):49–64.

Brewer, J. P. and B. H. Davis. 1992. Repetition and politeness in electronic classroom communities. Paper presented at the international meeting of ALLC and ACH, April, Oxford, England.

Brochet, M. 1987. Effective moderation of computer conferences: Notes and suggestions. In *Compendium of University of Guelph Papers on Computer Conferencing 1985–1987*, ed. C. Crosby, 1–20. Guelph, Ontario: University of Guelph.

Brookshire, R. G. 1991. Electronic bulletin boards as teaching tools in a university setting. Paper presented at the Tenth Annual Research Conference, Office Systems Research Association, March 1–3, Washington, D. C.

Burge, L. 1992. *Computer-Mediated Communication and Education: A Selected Bibliography.* Toronto: Ontario Institute for Studies in Education, Distance Learning Office.

Butler, G. and H. M. Jobe. 1987. The Australian-American connection. *The Computing Teacher* 14(7):25–26.

Castro, A. S. 1987. Teaching and learning as communication: The potentials and current applications of computer-mediated communication systems for higher distance education. In *Higher Level Distance Education: Perspectives for International Cooperation and New Developments in Technology*, 189–204. Victoria, Australia: United Nations Organization for Education, Science, and Culture.

Chonacky, N. 1991. *Collaborative Learning of Physics Through Electronic Mail: A Project to Improve the Skills of Physics Teachers.* Final Report. Brunswick, ME: Department of Physics, Bowdoin College.

Christensen, B. B. 1990. Teachers and CMC at Jutland Open University: A case study. In *Media and Technology in European Distance Education*, ed. A. W. Bates, 253–58. Milton Keynes, U.K.: European Association of Distance Teaching Universities.

Cohen, M. and N. Miyake. 1986. A worldwide intercultural network: Exploring electronic messaging for instruction. *Instructional Science* 15:257–73.

Conway, C. 1991. *Computer Use, Attitudes and Ownership Among AU Students: Implications for Computer-mediated Course Delivery.* Athabasca, Alberta: Athabasca University.

Cowan, D. D. and T. M. Stepien. (n.d.) Electronic communication and distance education. University of Waterloo, Waterloo, Ontario.

Cruz, A. 1991. An introduction to computer conferencing: A look at software available in the academic world. In *Proceedings of the Conference on Applications of Computer Conferencing to Teacher Education and Human Resource Development*, ed. A. J. Miller, 11–14. Columbus, OH: Ohio State University.

Davie, L. 1987. Learning through networks: A graduate course using computer conferencing. *Canadian Journal of University Continuing Education* 8(2):11–26.

Davie, L. 1988. Facilitating adult learning through computer-mediated distance education. *Journal of Distance Education* III(2):55–69.

Davie, L. 1989. Facilitation techniques for the on-line tutor. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 74–85. Oxford: Pergamon Press.

Davie, L. and R. Wells. 1991. Empowering the learner through computer-mediated communication. *The American Journal of Distance Education* 5(1):15–23.

Deutschman, B. W. 1984. Computer teleconferencing and independent study. In *Proceedings of the Exxon Conference on Computer-mediated Conferencing Systems and Their Potential,* ed. J. J. Manock, 13–23. Wilmington, NC: Office of Research Administration, University of North Carolina.

Dunkin, M. and B. Biddle. 1974. *The Study of Teaching.* New York: Holt, Rinehart and Winston.

Duranti, A. 1986. Framing discourse in a new medium: Openings in electronic mail. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition* 8(2):64–71.

Dvorak, J. C. and N. Anis. 1990. *Dvorak's Guide to PC Telecommunications.* Berkeley, CA: Osborne McGraw-Hill.

Feenberg, A. 1986. Network design: An operating manual for computer conferencing. *IEEE Transactions on Professional Communications PC*29(1):2–7.

Feenberg, A. 1987. Computer conferencing and the humanities. *Instructional Science* 16:169–86.

Feenberg, A. 1989. The written world. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 22–39. Oxford: Pergamon Press.

Feenberg, A. 1991. CMC in executive education: The WBSI experience. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon,* eds. A. Fjuk and A. E. Jenssen, 95–100. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Feenberg, A. and B. Bellman. 1990. Social factor research in computer-mediated communications. In *Online Education: Perspectives on a New Environment*, ed. L. M. Harasim, 67–97. New York: Praeger.

Fields, M. V. and R. M. Ryan. 1991. *Challenging the Barriers to Use of E-mail in Distance Education: A Field Experiment in Southeast Alaska.* Anchorage, Alaska: Center for Information Technology, College of Arts and Sciences, University of Alaska.

Fjuk, A. and A. E. Jenssen. 1991. Computer conferencing systems: Characteristics and requirements. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon,* eds. A. Fjuk and A. E. Jenssen, 19–24. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Gledhill, V. X. and C. P. Dudley. 1988. Electronic tutorial system for distance education. In *Developing Distance Education,* eds. D. Sewart and J. S. Daniel, 214–17. Oslo: International Council for Distance Education.

Glossbrenner, A. 1983. *The Complete Handbook of Personal Computer Communications: Everything You Need to Go Online With the World.* New York: St. Martin's Press.

Goodman, W. M. 1987. *Providing Hands-on Training at a Distance: Final Report on the Joint Study Between Academic Information Systems (IBM) and Durham College of Applied Arts and Technology.* Oshawa, Ontario: Durham College.

Goodrum, D. A. and R. A. Knuth. 1991. Supporting learning with process tools: Theory and design issues. Paper presented at the Association for Educational Communications and Technology Annual Conference, Orlando, Florida, February 13.

Greenberg, S. 1991. An annotated bibliography of computer supported cooperative work. In *Computer Supported Cooperative Work and Groupware*, ed. S. Greenberg, 365–413. London: Academic Press.

Greif, I., ed. 1988. *Computer-supported Cooperative Work: Readings in CSCW.* San Mateo, CA: Morgan Kaufmann.

Gunawardena, C. N., J. D. Gittinger, and L. P. Dvorak. 1991. The design, implementation and evaluation of a computer-mediated communication support system for medical students. In *Proceedings of the Seventh Annual Conference on Distance Teaching and Learning*, 98–102. Madison, Wisconsin: University of Wisconsin.

Hahn, H., J. L. Harbour, R. Wells, D. L. Schurman, and K. Daveline. 1990. *Distributed Training for the Reserve Component: Course Conversion and Implementation Guidelines for Computer Conferencing.* Research Product 90–25. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (Submitted to ERIC).

Hahn, H., R. L. Ashworth, R. H. Phelps, R. Wells, R. E. Richards, and K. Daveline. 1991. *Distributed Training for the Reserve Component: Remote Delivery Using Asynchronous Computer Conferencing.* Research Report 1581. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (Submitted to ERIC).

Harasim, L. 1986. Computer learning networks: Educational applications of computer conferencing. *Journal of Distance Education* I(1):59–70.

Harasim, L. 1987a. Computer-mediated cooperation in education: Group learning networks. In *Proceedings of the Second Guelph Symposium on Computer Conferencing*, 171–86. Guelph, Ontario: University of Guelph.

Harasim, L. 1987b. Teaching and learning on-line: Issues in computer-mediated graduate courses. *Canadian Journal of Educational Communication* 16(2):117–35.

Harasim, L. 1988. *On-line Group Learning/Teaching Methods.* Technical Paper #7. Toronto: Ontario Institute for Studies in Education.

Harasim, L. 1989. Online education: A new domain. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 50–62. Oxford: Pergamon Press.

Harasim, L. 1990a. Bibliography on educational CMC. In *Online Education: Perspectives on a New Environment*, ed. L. Harasim, 229–64. New York: Praeger.

Harasim, L. M., ed. 1990b. *Online education: Perspectives on a New Environment.* New York: Praeger.

Harasim, L. M., ed. In press. *Globalizing Networks: Computers and International Communication.* Cambridge, MA: MIT Press.

Harasim, L. M., Hiltz, S. R., Teles, L., and Turoff, M. In press. *Learning Networks: A Field Guide.* Cambridge, MA: MIT Press.

Harbour, J., K. Daveline, R. Wells, D. Schurman, and H. Hahn. 1990. *Distributed Training for the Reserve Component: Instructor Handbook for a System for Managing Asynchronous Remote Training.* Research Product 90–24. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (Submitted to ERIC).

Hardy, G., V. Hodgson, D. McConnell, and M. Reynolds, 1991. *Computer Mediated Communication for Management Training and Development: A Research Report.* Lancaster, U.K.: Centre for the Study of Management Learning, The Management School, Lancaster University.

Harry, K. 1990. The collection and dissemination of information on distance education: The resources and role of the International Centre for Distance Learning. In *Media and Technology in European Distance Education*, ed. A. W. Bates, 67–72. Milton Keynes, U.K.: European Association of Distance Teaching Universities.

Hart, R. 1987. Towards a third generation distributed conferring system. *Canadian Journal of Educational Communication*, 16(2):137–52.

Hartman, K., C. M. Neuwirth, S. Kiesler, L. Sproull, C. Cochran, M. Palmquist, and D. Zubrow. 1991. Patterns of social interaction and learning to write: Some effects of network technologies. *Written Communication* 8(1):79–113.

Heap, N. 1989. Technological choices for learning networks. In *The Use of Computer Networks for Education and Training*, 104–19. Moorfoot, Sheffield, U.K.: Training Agency. (Report to the Learning Technology Unit, Training Agency).

Heap, N. 1990. Implementing learning networks: A large scale case study. In *Proceedings of the Third Guelph Symposium on Computer Conferencing*, 28–36. Guelph, Ontario: University of Guelph.

Henri, F. In press. Distance learning and computer-mediated communication: Interactive, quasi-interactive or monologue? In *Computer Supported Collaborative Learning*, ed. C. O'Malley. Heidelberg: Springer-Verlag.

Hiltz, S. R. 1984. The virtual classroom. In *Proceedings of the Exxon Conference on Computer-mediated Conferencing Systems and Their Potential*, ed. J. J. Manock, 70–73. Wilmington, NC: Office of Research Administration, University of North Carolina.

Hiltz, S. R. 1986. The "virtual classroom": Using computer-mediated communication for university teaching. *Journal of Communication* 36(2):95–104.

Hiltz, S. R. 1990. Evaluating the virtual classroom. In *Online Education: Perspectives on a New Environment*, ed. L. M. Harasim, 133–83. New York: Praeger.

Hiltz, S. R., H. Shapiro, and M. Ringsted. 1990. Collaborative teaching in a virtual classroom. In *Proceedings of the Third Guelph Symposium on Computer Conferencing*, 37–55. Guelph, Ontario: University of Guelph.

Hiltz, S. R. and M. Turoff. 1978. *The Network Nation.* Reading, MA: Addison-Wesley.

Hiltz, S. R. and M. Turoff. 1985. Structuring computer-mediated communication systems to avoid information overload. *Communications of the ACM* 28(7):680–89.

Ingesman, L. 1991. Teaching the teachers: Aspects of distance teaching. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 147–50. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Johnson-Lenz, P. and T. Johnson-Lenz. 1990. *Rhythms, Boundaries, and Containers: Creative Dynamics of Asynchronous Group Life.* Research Report #4. Lake Oswego, Oregon: Awakening Technology.

Johnson-Lenz, P. and T. Johnson-Lenz. 1991. Post-mechanistic groupware primitives: Rhythms, boundaries and containers. *International Journal of Man-Machine Studies*, 34:395–417.

Kalaja, P. and S. Leppänen. 1991. "Hello, it's me again": Process writing and computer conferencing in EFL. In *Proceedings of the EUROCALL Conference on Computer-assisted Language Learning*, eds. H. Savolainen and J. Telenius, 341–48. Helsinki: Department of Languages and the Helsinki School of Economics and Business Administration.

Kaye, A. 1987. Integrating computer conferencing into distance education courses: A discussion paper. In *Proceedings of the Second Guelph Symposium on Computer Conferencing*, 23–32. Guelph, Ontario: University of Guelph.

Kaye, A. 1989. Computer-mediated communication and distance education. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 3–21. Oxford: Pergamon Press.

Kaye, A. 1990. Building the foundations for an electronic campus. In *Media and Technology in European Distance Education*, ed. A. W. Bates, 227–34. Milton Keynes, U.K.: European Association of Distance Teaching Universities.

Kaye, A. 1991. Computer networking in distance education: Multiple uses, many models. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 43–51. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Kearsley, G. and W. Lynch. 1991. Computer networks for teaching and research: Changing the nature of educational practice and theory. *DEOSNEWS* 1(18).

Kerr, E. B. 1986. Electronic leadership: A guide to moderating online conferences. *IEEE Transactions on Professional Communications* PC 29(1):12–18.

Kinnaman, D. 1991a. Move over public television: Here comes the National Public Telecomputing Network. *Technology and Learning Magazine* (Nov./Dec.):14

Kinnaman, D. 1991b. National space shuttle simulation project "takes off." *Technology and Learning Magazine* (Nov./Dec.):12.

Kirkwood, A. 1988. Computers in distance education: Student access and issues of openness. *Open Learning* 3(3):18–22.

Kirkwood, A. 1989. Evaluating a major innovation in distance education: The home computing policy of the U.K. Open University. *Research in Distance Education* 1(2):5–6.

Kling, R. 1991. Syllabus for Computerization in Society. *Commed News List* (September 25).

Konttinen, R. and M. Marttunen. 1991. Argumentation and learning in computer-mediated communication among university students. Paper presented at a conference, Research on Learning and Instruction, Turku Finland, August 24–28.

89

Konttinen, R. and K. Sajavaara. 1990. Towards an electronic campus: Utopia or reality? *Life and Education in Finland* 1(1):48–54.

Larsen, I. B. and A. C. Malmberg. 1991. *LEARN Report: Education Via Network.* Copenhagen, Denmark: Royal Danish School of Educational Studies.

Levin, J. and M. Cohen. 1985. The world as an international science laboratory: Electronic networks for science instruction and problem-solving. *Computers in Mathematics and Science Teaching* (Summer):33–35.

Levin, J. A., H. Kim, and M. M. Riel. 1990. Analyzing instructional interactions on electronic message networks. In *Online Education: Perspectives on a New Environment*, ed. L. M. Harasim, 185–213. New York: Praeger.

Levin, J. A., M. Riel, N. Miyake, and M. Cohen. 1987. Education on the electronic frontier: Teleapprentices in globally distributed educational contexts. *Contemporary Educational Psychology* 12:254–60.

Levin, J. A., A. Rogers, M. Waugh, and K. Smith. 1989. Observations on electronic networks: Appropriate activities for learning. *The Computing Teacher* 16(8):17–21.

Levinson, P. 1989. Media relations: Integrating computer telecommunications with educational media. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 40–49. Oxford: Pergamon Press.

Lewis, R. 1991. Computer-mediated communications support in business classes. *AEDNET* (July 8). Syracuse, NY: Syracuse University.

Lorentsen, A. 1989a. Evaluation of computer conferencing in open learning. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 196–98. Oxford: Pergamon Press.

Lorentsen, A. 1989b. *Presentation and Analysis of "Project Computer-Aided Distance Teaching": A Research Project at Jutland Open University.* Aalborg, Denmark: Aalborg University (AUC), Department of Language and Intercultural Studies.

Manninen, J. 1991. Computer conference as learning environment: Experiences from computer-mediated facilitating. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 81–85. Oslo: NKS Ernst, G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Marantz, B. and R. England. 1992. Closing the distance: A CMC learning contract tutorial. *DEOSNEWS* 2(4).

Marshall, J. G. 1987. The use of data-conferencing as an instructional technique. In *Proceedings of the Second Guelph Symposium on Computer Conferencing*, 151–54. Guelph, Ontario: University of Guelph.

Marttunen, M. 1991. *Argumentative Academic Discourse-seminar: Improving Argumentation Skills Through Computer Conferencing.* Institute for Educational Research, University of Jyväskylä: Jyväskylä, Finland.

Mason, R. 1987. Computer conferencing: Its contribution to self-directed learning. In *Proceedings of the Second Guelph Symposium on Computer Conferencing*, 33–39. Guelph, Ontario: University of Guelph.

Mason, R. 1989a. A case study of the use of computer conferencing at the Open University. Ph.D. diss., CITE Thesis No. 6, Open University, Milton Keynes.

Mason, R. 1989b. An evaluation of CoSy on an Open University course. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 115–45. Oxford: Pergamon Press.

Mason, R. 1990a. Computer conferencing in distance education. In *Media and Technology in European Distance Education*, ed. A. W. Bates, 221–26. Milton Keynes, U.K.: European Association of Distance Teaching Universities.

Mason, R. 1990b. Conferencing for mass distance education. In *Proceedings of the Third Guelph Symposium on Computer Conferencing*, 56–64. Guelph, Ontario: University of Guelph.

Mason, R. 1991. Moderating educational computer conferencing. *DEOSNEWS* 1(19).

Mason, R. In press a. Analysing computer conferencing interactions. *The International Journal of Computers in Adult Education and Training.*

Mason, R. ed. In press b. *Computer Conferencing: The Last Word.* London: Beach Holme.

Mason, R. and A. Kaye, eds. 1989. *Mindweave: Communication, Computers, and Distance Education.* Oxford: Pergamon Press.

Mason, R. and T. Kaye. 1990. Toward a new paradigm for distance education. In *Online Education: Perspectives on a New Environment*, ed. L. Harasim, 15–38. New York: Praeger.

McCreary, E. K. and J. Van Duren. 1987. Educational applications of computer conferencing. *Canadian Journal of Educational Communication* 16(2):107–15.

McDonald, F., and P. Elias. 1976. *Beginning Teacher Evaluation Study: Phase II Final Report.* Princeton, NJ: Educational Testing Service.

Meurs, C. E. J.van, and P. A. J. Bouhuijs. 1989. Tele-education: An experiment on home computing at the Dutch Open University. *Open Learning* 4(1):33–36.

Misanchuk, E. R. 1989. *Summary Report: Sociology 110 Distance Education Pilot Project Using Microcomputers for Communication.* Saskatoon, SK: Division of Extension and Community Relations, University of Saskatchewan.

Mills, M. 1987. Computer alliances for international faculty development. In *Proceedings of the Second Guelph Symposium on Computer Conferencing*, 41–50. Guelph, Ontario: University of Guelph.

Muzio, J. 1989. Email and electronic transfer of data files for a distance education course. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 198–201. Oxford: Pergamon Press.

Newman, D., S.V. Goldman, D. Brienne, I. Jackson, and S. Magzamen. 1989. Computer mediation of collaborative science investigations. *Journal of Educational Computing Research* 5(2):151–66.

Nipper, S. 1989. Third generation distance learning and computer conferencing. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 63–73. Oxford: Pergamon Press.

O'Malley, C., ed. In press. *Computer Supported Collaborative Learning.* Heidelberg: Springer-Verlag.

Ohler, J. 1991. *Online Communication and Distance Education*, version 1.3. Juneau, Alaska: University of Alaska Southeast.

Okerson, A. ed. 1992. *Directory of Electronic Journals, Newsletters, and Academic Discussion Lists.* Washington, DC: Association of Research Libraries.

Olsen, B. 1991. How to succeed with CAKE (Computer aided knowledge exchange). In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 151–57. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Osgood, D. 1986. The electronic university network. *Byte* (March):171–72, 174, 176.

Owen, T. 1989. Computer-mediated writing: The writer in electronic residence. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 208–11. Oxford: Pergamon Press.

Palme, J. 1991a. I. A comparison of techniques for distributed data bases in message systems. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 9–12. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Palme, J. 1991b. II. Extracts from current ISO/CCITT group communication working papers. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 13–17. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Paulsen, M. F. 1987/1988. In search of a virtual school. *T.H.E. Journal* (Dec./Jan.):71–76.

Paulsen, M. F. 1989. EKKO: A virtual school. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 201–7. Oxford: Pergamon Press.

Paulsen, M. F. 1990a. Organizing an electronic college. In *Proceedings of the Third Guelph Symposium on Computer Conferencing*, 87–97. Guelph, Ontario: University of Guelph.

Paulsen, M. F. 1990b. The seven entities of computer conferencing systems: An electronic college approach. In *The Electronic College: Selected Articles From the EKKO Project*, eds. M. F. Paulsen and T. Rekkedal, 33–46. Bekkestua, Norway: NKI.

Paulsen, M. F. 1992. The NKI Electronic College: Five years of computer conferencing in distance education. *DEOSNEWS* 2(9). University Park, PA: The American Center for the Study of Distance Education.

Paulsen, M. F. and T. Rekkedal. 1990. Experiences with the EKKO computer-conferencing system at NKI. In *The Electronic College: Selected Articles From the EKKO Project*, eds. M.F. Paulsen and T. Rekkedal, 67–78. Bekkestua, Norway: NKI.

Peyton, J. K. 1989. Computer networks for real-time written interaction in the writing classroom: An annotated bibliography. *Computers and Composition* 6(3):105–22.

Peyton, J. K., J. Scully, and J. Parker. 1991. *The ENFI Project: Annotated Publications and Reports*. Washington DC: The Gallaudet ENFI Project.

Phelps, R. H., R. A. Wells, R. L. Ashworth, and H. Hahn. 1991. Effectiveness and costs of distance education using computer-mediated communication. *The American Journal of Distance Education* 5(3):7–19.

Phillips, G. M., G. M. Santoro, and S. A. Kuehn. 1988. The use of computer-mediated communication in training students in group problem-solving and decision-making techniques. *The American Journal of Distance Education* 2(1):38–51.

Quale, A. 1990. EKKO–BASE: An online multiuser selfstudy database. In *The Electronic College: Selected Articles From the EKKO Project*, eds. M. F. Paulsen and T. Rekkedal, 115–23. Bekkestua, Norway: NKI.

Quarterman, J. S. 1989. *The Matrix: Computer Networks and Conferencing Systems Worldwide*. Bedford, MA: Digital Press.

Quarterman, J. S. and J. C. Hoskins. 1986. Notable computer networks. *Communications of the ACM* 29(10):932–71.

Quinn, C. N., H. Mehan, J. A. Levin, and S. D. Black, 1983. Real education in non-real time: The use of electronic message systems for instruction. *Instructional Science* 11:313–27.

Rapaport, M. 1991. *Computer Mediated Communications: Bulletin Boards, Computer Conferencing, Electronic Mail, and Information Retrieval*. New York: John Wiley & Sons.

Rasmussen, T. 1991. When academia goes on-line: A social experiment with electronic conferencing for the Nordic media research community. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Datafornidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 165–69. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Rekkedal, T. 1990. Recruitment and study barriers in the electronic college. In *The Electronic College: Selected Articles From the EKKO Project*, eds. M. F. Paulsen and T. Rekkedal, 79–105. Bekkestua, Norway: NKI.

Rekkedal, T. and M. F. Paulsen. 1990. Computer conferencing in distance education: Status and trends. In *The Electronic College: Selected Articles From the EKKO Project*, eds. M. F. Paulsen and T. Rekkedal, 47–58. Bekkestua, Norway: NKI.

Riedl, R. 1989. Patterns in computer-mediated discussions. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 215–20. Oxford: Pergamon Press.

Riel, M. 1985. The Computer Chronicles Newswire: A functional learning environment for acquiring literacy skills. *Journal of Educational Computing Research* 1(3):317–37.

Riel, M. 1987. The Intercultural Learning Network. *The Computing Teacher* 14(7):27–30.

Rogers, A., Y. Andres, M. Jacks, and T. Clausen. 1990. Keys to successful telecomputing. *The Computing Teacher* 17(8):25–28.

Rohfeld, R., D. Eastmond, C. Gunawardena, and W. Davidson. 1991. Facilitating effective computer discussion for collaborative learning at a distance. In *Proceedings of the Seventh Annual Conference on Distance Teaching and Learning*, 155–59. Madison, Wisconsin: University of Wisconsin.

Rønning, F. 1991. Distance education in mathematics using electronic communication and CAL software. In *Proceedings Nordisk Konferanse om Fjernundervisning, Opplæring og Dataformidlet Kommunikasjon*, eds. A. Fjuk and A. E. Jenssen, 93–94. Oslo: NKS Ernst G. Mortensens Stiftelse and Universitetets Senter for Informasjonsteknologi (USIT).

Røyrvik, O., J. Dawes, and O. P. Harv. 1991. Using a CoSy conference system at the NKI College of Engineering. In *Proceedings of the Nordic Conference on Computer-Aided Higher Education*, 341–51. Otaniemi, Finland: Helsinki University of Technology.

Rumble, G. 1989. On-Line costs: Interactivity at a price. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 146–65. Oxford: Pergamon Press.

Sayers, D. and K. Brown. 1987. Bilingual education and telecommunications: A perfect fit. *The Computing Teacher* 14(7):23–24.

Schmitt, B. 1991. Developments of educational software and tools for computer aided distance education by CLEO. In *Proceedings of the Nordic Conference on Computer-Aided Higher Education*, 381–89. Otaniemi, Finland: Helsinki University of Technology.

Scigliano, J. A., D. L. Joslyn, and J. Levin. 1989. ECR: An online classroom for the non-school learning environment. *Technological Horizons in Education* 16(6):63–67.

Scriven, B. 1988. The use of electronic mail in distance education. In *Developing Distance Education*, eds. D. Sewart and J. S. Daniel, 391–95. Oslo: International Council for Distance Education.

Seaton, W. J. 1989. Computer assisted lifelong learning: New pathways to higher education. *ICDE Bulletin* 21(September):36–43.

Sharan, S. 1980. Cooperative learning in small groups: Recent methods and effects on achievement, attitudes, and ethnic relations. *Review of Educational Research* 50:241–71.

Simpson, H. and H. L. Pugh. 1990. *A Computer-based Instructional Support Network: Design, Development, and Evaluation.* Research Report NPRDC-TR-90-6. San Diego, CA: Navy Personnel Research and Development Center.

Slavin, R. E. 1980. Effects of student teams and peer tutoring on academic achievement and time-on-task. *Journal of Experimental Education* 48:252–57.

Smith, K. 1990. Collaborative and interactive writing for increasing foreign language communication skills. *Hispania* 73(1):77–87.

Smith, R. C. 1988. Teaching special relativity through a computer conference. *American Journal of Physics* 56(2):142–47.

Søby, M. 1990. Traversing distances in education: The PortaCOM experiment. In *Media and Technology in European Distance Education*, ed. A. W. Bates, 241–47. Milton Keynes, U.K.: European Association of Distance Teaching Universities.

Teles, L. and N. Duxbury. 1991. *The Networked Classroom: An Assessment of the Southern Interior Telecommunications Project* (SITP). Phase 1: Final Report. Burnaby, BC: Faculty of Education, Simon Fraser University.

Thomas, R. 1989a. Implications for conventional institutions of Open University experience in use of computer conferences. *Computers in Adult Education and Training* 1(3):5–17.

Thomas, R. 1989b. The implications of electronic communication for the Open University. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 166–77. Oxford: Pergamon Press.

Thomas, R. 1990. Benefits and costs of computer conferencing in adult education. *Intelligent Tutoring Media* 1(2):65–72.

Thompson, L. 1991. Designing and implementing an effective computer based tutorial system as a means of improving the quality of distance education programs. Paper presented at the Australia and South Pacific External Studies Association, July, Bathurst, New South Wales.

Training Agency. 1989. *The Use of Computer Networks for Education and Training.* Moorfoot, Sheffield, U.K.: Training Agency. (Report to the Learning Technology Unit, Training Agency).

Turoff, M. 1990. Foreword. In *Online Education: Perspectives on a New Environment*, ed. L. M. Harasim, ix–xiii. New York: Praeger.

Turoff, M. 1991. Computer-mediated communication requirements for group support. *Journal of Organizational Computing* 1:85–113.

Vallee, J., R. Johansen, R. H. Randolph, and A. C. Hastings. 1974. *A Study of Social Effects* Vol. 2 of *Group Communication Through Computers.* Menlo Park, CA: Institute for the Future.

Vallee, J., R. Johansen, H. Lipinski, K. Spangler, T. Wilson, and A. Hardy. 1975. *Pragmatics and Dynamics* Vol. 3 of *Group Communication Through Computers.* Menlo Park, CA: Institute for the Future.

Van Duren, J. 1989. CMC at Athabasca University. In *Mindweave: Communication, Computers, and Distance Education*, eds. R. Mason and A. Kaye, 211–14. Oxford: Pergamon Press.

Waggoner, M. C., ed. 1992. *Empowering Networks: Computer Conferencing in Education.* Englewood Cliffs, NJ: Educational Technology Publishers.

Webb, N. 1982. Peer interaction and learning in cooperative small groups. *Journal of Educational Psychology* 74:642–55.

Webb, N. 1984. Stability of small group interaction and achievement over time. *Journal of Educational Psychology* 76(2):211–24.

Wells, R. 1991a. *Computer-mediated Communications for Distance Education and Training: Literature Review and International Resources* Research Product 91-06. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (Submitted to ERIC).

Wells, R. 1991b. Open access issues in distance courses delivered by computer-mediated communication (CMC). In *Proceedings of the Conference on The Student, Community, and Curriculum: International Perspectives on Open and Distance Learning*, ed. A. Tait, 323-30. Cambridge: Open University.

Wilson, D. L. 1991. Testing time for electronic journals. *Chronicle of Higher Education* September 11, A22-A24.

ABOUT THE AUTHOR

Dr. Wells is Distance Education Specialist at the Centre for Distance Education at Athabasca University. Her work involves: consulting with faculty on CMC course design and teaching; authoring training manuals for faculty and students in the pedagogy of CMC; providing input to administrators regarding the institutional impacts of CMC on Athabasca's resources and current models of course delivery. She may be contacted at Athabasca University, P.O. Box 10,000, Athabasca, Alberta, Canada T0G 2R0. Internet address: rosaliew@cs.athabascau.ca

The monograph was designed and produced by Margaret Koble and Janet Hartranft. Address: The Pennsylvania State University, The American Center fo the Study of Distance Education, 403 South Allen Street, Suite 206, University Park, PA 16801-5202.

Publications Available from:

The American Center for the Study of Distance Education

The Center publishes a series of research monographs in conformity with its mission of promoting distance education research, study, scholarship, and teaching.

International Perspectives on Distance Education Research

Papers Presented at the Preconference Workshop, ICDE World Conference, Caracas, Venezuela, November 2-4 1990

This publication on research in distance education includes articles on qualitative research methodology, European distance education research, and experimental methods in distance education research. (60 pages)

ACSDE Research Monograph No. 5 **$15.00**

Distance Education Symposium: Selected Papers

Part 1

The first in a three part series, Part 1 contains articles based on discussion papers of The Second American Symposium on Research in Distance Education held at Penn State University in May 1991. This monograph focuses on research issues in the areas of instruction and learner support; learning and characteristics of learners; and theory, policy, and management. (73 pages)

ACSDE Research Monograph No. 4 **$20.00**

A Survey of State-Level Involvement in Distance Education at the Elementary and Secondary Levels

This monograph by Richard England addresses the issues of state involvement in distance education and related teacher certification issues. (34 pages)

ACSDE Research Monograph No. 3 **$7.50**

Report on The Second American Symposium on Research in Distance Education

This publication reports on the distance education research symposium held May 22-24, 1991 at Penn State University. It includes abstracts of participants' discussion papers and a proposed research agenda. (51 pages)

Symposium Report **$10.00**

Forthcoming from ACSDE:

ACSDE Research Monograph No. 7

From Bulletin Boards to Electronic Universities: Distance Education, Computer-Mediated Communication, and Online Education

Morten Flate Paulsen

For information or to order, write:

The American Center for the Study of Distance Education
College of Education
The Pennsylvania State University
403 South Allen Street, Suite 206
University Park, PA 16801-5202
Telephone: (814) 863-3764
E-mail: MAK1Ø@PSUVM.PSU.EDU

The American Journal of Distance Education

The American Journal of Distance Education is published in the College of Education at The Pennsylvania State University by The American Center for the Study of Distance Education. **The Journal** is designed for trainers in corporations; teachers in schools, colleges, and universities; researchers; adult educators; and other specialists in education and communications. Created to disseminate information and act as a forum for criticism and debate about research and practice of distance education in the Americas, **The Journal** focuses on the latest program ideas, research, and developments in methods and systems for the delivery of education at a distance. **The Journal** is issued three times a year.

SELECTED CONTENTS

Values at a Distance: Paradox and Promise
HENRY C. JOHNSON, JR. (Vol. 6 No. 1)

Effectiveness and Costs of Distance Education Using Computer-Mediated Communication
RUTH H. PHELPS ET AL. (Vol. 5 No. 3)

Value Chain Analysis: A Framework for Management in Distance Education
ANDREW WOUDSTRA and RICHARD POWELL (Vol. 3 No. 3)

An Instrument for Evaluating the Potential Effectiveness of Electronic Distance Education Systems
S. TODD STUBBS and BYRON R. BURNHAM (Vol. 4 No. 3)

Looking at Distance Education Through an Educational Technologist's Eyes
ELLEN D. WAGNER (Vol. 4 No. 1)

A Fourth Generation Distance Education System: Integrating Computer-Assisted Learning and Computer Conferencing
ALLAN C. LAUZON and GEORGE A. B. MOORE (Vol. 3 No. 1)

Broadening the Definition of Distance Education in Light of the New Telecommunications Technologies
BRUCE O. BARKER ET AL. (Vol. 3 No. 1)

Empowering the Learner Through Computer-Mediated Communication
LYNN E. DAVIE and ROSALIE WELLS (Vol. 5 No. 1)

Beyond Independence in Distance Education: The Concept of Control
D. R. GARRISON and MYRA BAYNTON (Vol. 1 No. 3)

The Use of Computer-Mediated Communication in Training Students in Group Problem-Solving and Decision-Making Techniques
GERALD M. PHILLIPS, GERALD M. SANTORO, and SCOTT A. KUEHN (Vol. 2 No. 1)

For information write to:

The American Journal of Distance Education
College of Education
The Pennsylvania State University
403 South Allen Street, Suite 206
University Park, PA 16801-5202
Tel: (814) 863-3764
Internet: MAK1Ø@PSUVM.PSU.EDU

The American Center
for the Study of Distance Education
Research Monograph Series

This series is published in conformity with the ACSDE's mission of promoting distance education research, study, scholarship, and teaching and serving as a clearinghouse for the dissemination of knowledge about distance education. It complements the comprehensive scope of *The American Journal of Distance Education* by providing a forum for articles of a more technical or specialized nature.

The American Center
for the Study of Distance Education
College of Education
The Pennsylvania State University
403 South Allen Street, Suite 206
University Park, PA 16801-5202

Tel: (814) 863-3764
Fax: (814) 865-5878
E-mail address: MAK1Ø@PSUVM.PSU.EDU